UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

JUN 22 2005

In response refer to:
151422SWR1999SA1277:MET

Frank Michny
Regional Environmental Officer
United States Bureau of Reclamation
2800 Cottage Way
Sacramento, California 95825

Dear Mr. Michny:

This document transmits NOAA's National Marine Fisheries Service's (NMFS) biological and conference opinion (Enclosure 1) based on our review of the proposed Battle Creek Salmon and Steelhead Restoration project (Restoration project) on Battle Creek in Shasta and Tehama Counties, California, and its effects on federally-listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened Central Valley steelhead (*O. mykiss*), and proposed critical habitat for Central Valley spring-run Chinook salmon and Central Valley steelhead, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your request for formal consultation was received on April 22, 2004.

This biological and conference opinion is based on information provided in the April 2004, Action Specific Implementation Plan for the Restoration project, several meetings with the U.S. Bureau of Reclamation and their consultants, field investigations, and other sources of information. A complete administrative record of this consultation is on file at the NMFS Sacramento Area Office.

Based on the best available scientific and commercial information, the biological and conference opinion concludes that this project is not likely to jeopardize the continued existence of the above listed species, or adversely modify proposed critical habitat. NMFS also has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to minimize incidental take associated with the Restoration project.

Also enclosed are Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon as required by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). This document concludes that construction activities associated with the proposed Restoration project will adversely affect the EFH of Pacific salmon in the action area and adopts the ESA conservation recommendation from the biological opinion as the EFH conservation recommendation.

Please contact Mr. Michael Tucker at (916) 930-3604, or via e-mail at michael.tucker@noaa.gov if you have any questions concerning this matter, or require additional information.

Sincerely,

Anthony C. Marton

for Rodney R. McInnis
Regional Administrator

Enclosures (2)

Enclosure 1

BIOLOGICAL AND CONFERENCE OPINION

Agency: U.S. Bureau of Reclamation

Activity: Battle Creek Salmon and Steelhead Restoration Project

Consultation Conducted By: Southwest Region, National Marine Fisheries Service

File Number: 151422SWR1999SA1277:MET

Date Issued: JUN 22 2005

I. CONSULTATION HISTORY

Development of the Battle Creek Salmon and Steelhead Restoration project (Restoration project) was initiated in 1999 through the formation of partnerships supportive of restoration activities throughout the Battle Creek watershed. In early 1999, a cooperative effort among the U.S. Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (FWS), NOAA's National Marine Fisheries Service (NMFS), California Department of Fish and Game (CDFG), and Pacific Gas and Electric Company (PG&E) led to the signing of an Agreement in Principle by these parties to pursue a restoration project for Battle Creek. In mid-1999, the parties signed a detailed, formal memorandum of understanding (MOU) in conformance with the Agreement in Principle, allowing the release of $28 million in State and Federal funding for the agencies' responsibilities in the partnership.

Since the signing of the MOU, Reclamation, FWS, NMFS, CDFG, and PG&E have been working together to develop the Restoration project. Additionally, the Restoration project has been developed through the contributions and efforts of the public, interested parties, the Battle Creek Working Group (BCWG), the Battle Creek Watershed Conservancy, the California Bay Delta Authority (CALFED), the California State Water Resources Control Board (SWRCB), and the Federal Energy Regulatory Commission (FERC). Reclamation has assumed the role as the lead Federal agency for the purpose of conducting formal Endangered Species Act (ESA) consultation.

Representatives from CDFG, NMFS, and FWS that participated in the development of the Restoration project have also assisted with the preparation of an Action Specific Implementation Plan (ASIP) which has been submitted to NMFS by Reclamation and is intended to serve as the official biological assessment (BA) for the Restoration project. In anticipation of the proposed designation of the project action area as critical habitat for Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley steelhead (*O. mykiss*), the BA included necessary information to allow NMFS to analyze the potential impacts of the project on proposed critical habitat for these two species. Open communication among the participating agencies (including face-to-face meetings, conference calls, and e-mail messages) was maintained throughout the development of the BA to ensure that all project-related effects were addressed in that document and to ensure that appropriate conservation measures were included.

Formal consultation was initiated by Reclamation on April 22, 2004, through the submission of the BA to NMFS. However, several amendments and revisions to the project description and other aspects of the BA were necessary. The final revision to the project description was received by NMFS on December 18, 2004.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Construction Activities and Facility Modifications

The Restoration project proposes to modify the PG&E hydroelectric facilities on Battle Creek to provide habitat conditions consistent with the life history requirements of anadromous salmonids. Project facilities that will be modified include: the North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Lower Ripley Creek Feeder, Inskip, Soap Creek Feeder, South, and Asbury Diversion Dams; the Eagle Canyon, Wildcat, Inskip, and South Canals; and the Inskip and South Powerhouses (Table 1; Figure 1).

Increasing minimum instream flows is an integral component of the Restoration project. The BCWG Biological Technical Team collaboratively developed a detailed minimum flow release schedule for each dam. The Biological Technical Team included biologists from government fishery agencies and PG&E, and participants from the BCWG. The proposed flow schedule is broken down by stream reach and is intended to provide minimum flows that support free passage and suitable water temperatures.

The Restoration project provides the following modifications to the hydroelectric project that will achieve the restoration of ecological processes important to anadromous fish.

- Adjustments to hydroelectric project operations, including: allowing cold spring water to reach natural stream channels, decreasing the amount of water diverted from streams, and decreasing the rate and manner in which water is withdrawn from the stream and returned to the canals and powerhouses following outages.

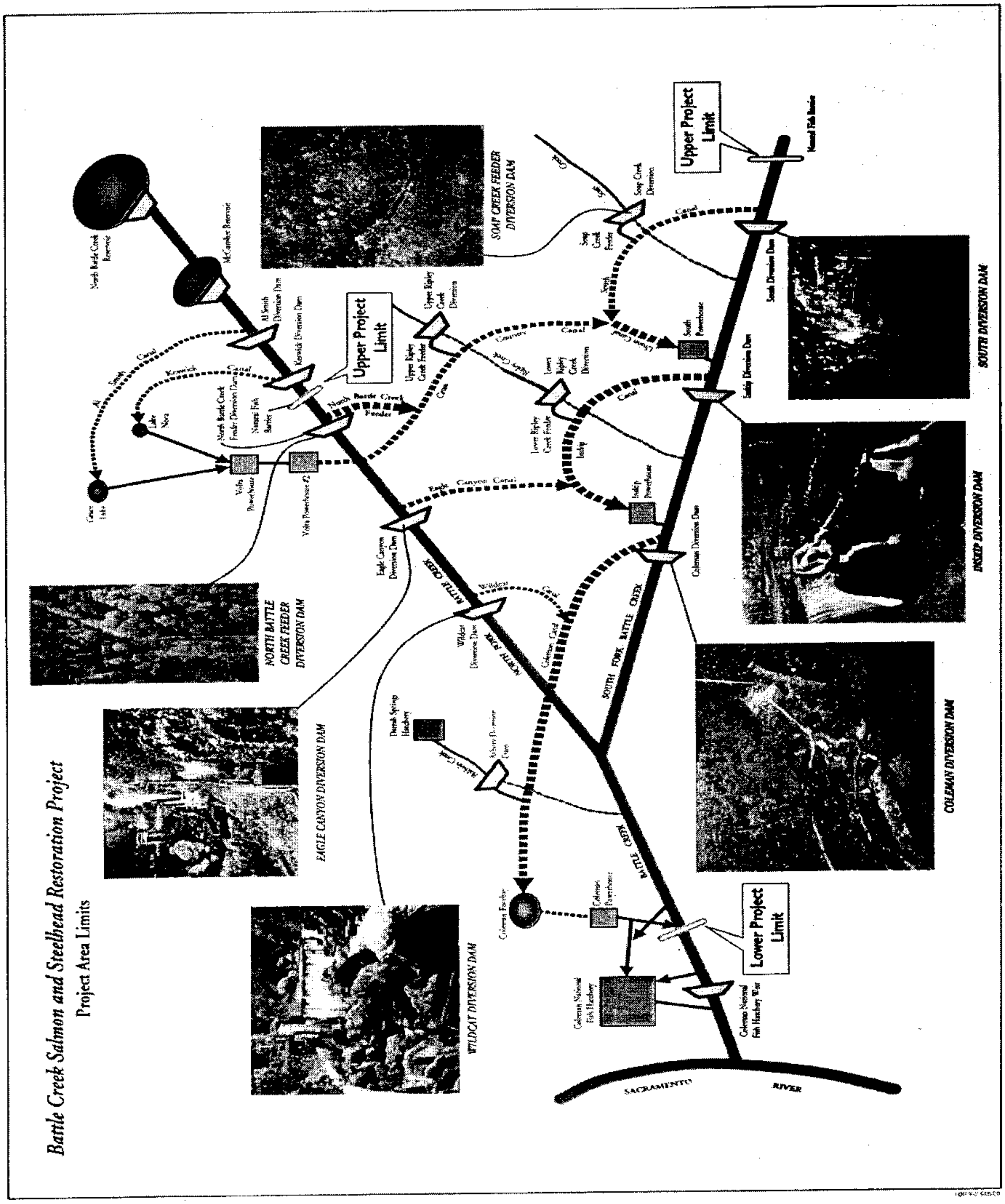
- Modification of facilities, such as fish ladders, fish screens and bypass facilities, diversion dams, canals and powerhouse discharge facilities.

- Changes in the approach used to manage the hydroelectric project to balance hydroelectric energy production with habitat needs, using ecosystem-based management that protects and enhances fish and wildlife resources and other environmental values using adaptive management, reliable facilities, and water rights transfers, among other strategies.

Table 1. Restoration Project Components

Site Name	Component
North Battle Creek Feeder Diversion Dam	55-cubic feet per second (cfs) fish screen Fish ladder Minimum instream flow set for North Battle Creek Feeder reach
Eagle Canyon Diversion Dam and Canal	70-cfs fish screen Fish ladder Removal of a segment of the Eagle Canyon spring collection facility Minimum instream flow set for Eagle Canyon reach
Wildcat Diversion Dam and Canal	Dam and appurtenant facilities removed
South Diversion Dam and Canal	Dam and appurtenant facilities removed
Soap Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
Inskip Diversion Dam and Canal, and South Powerhouse	220-cfs fish screen Fish ladder Construction of South Powerhouse and Inskip Canal connector (tunnel) Minimum instream flow set for Inskip reach
Lower Ripley Creek Feeder Diversion Dam	Dam and appurtenant facilities removed
Coleman Diversion Dam and Inskip Powerhouse	Dam removed Construction of Inskip Powerhouse and Coleman Canal connector Inskip Powerhouse bypass replaced
Asbury Diversion Dam	Reoperate to provide minimum instream flow Flow measurement weirs and fish barrier installed

Figure 1.



Battle Creek Salmon and Steelhead Restoration Project
Project Area Limits
North Battle Creek Reservoir
McCumber Reservoir
Al Smith Diversion Dam
Keswick Diversion Dam
Upper Project Limit
North Battle Creek Feeder Diversion Dam
Natural Fish Barrier
North Battle Creek Feeder
Al Smith Canal
Keswick Canal
Lake Nora
Grace Lake
Volta Powerhouse
Volta Powerhouse #2
Eagle Canyon Canal
Eagle Canyon Diversion Dam
NORTH BATTLE CREEK FEEDER DIVERSION DAM
EAGLE CANYON DIVERSION DAM
WILDCAT DIVERSION DAM
Wildcat Canal
Wildcat Diversion Dam
NORTH FORK BATTLE CREEK
Coleman Canal
Darrah Springs Hatchery
Asbury Diversion Dam
Coleman Forebay
Coleman Powerhouse
Coleman National Fish Hatchery
Coleman National Fish Hatchery Weir
Lower Project Limit
BATTLE CREEK
SACRAMENTO RIVER
SOUTH FORK BATTLE CREEK
Coleman Diversion Dam
COLEMAN DIVERSION DAM
Inskip Powerhouse
Inskip Diversion Dam
INSKIP DIVERSION DAM
Inskip Canal
Lower Ripley Creek Feeder
Lower Ripley Creek Diversion
Upper Ripley Creek Feeder
Upper Ripley Creek Diversion
Upper Project Limit
Cross Country Canal
South Powerhouse
South Diversion Dam
SOUTH DIVERSION DAM
Soap Creek Feeder
Soap Creek Diversion
SOAP CREEK FEEDER DIVERSION DAM
Natural Fish Barrier

Restoration of these ecological processes is expected to provide:

- improved amounts of otherwise production-limiting spawning and rearing habitat;
- unimpeded access by anadromous salmonids to their preferred habitats;
- instream water temperature profiles that are improved and approach the magnitude and thermal continuity of those conditions under which anadromous fish populations have evolved in Battle Creek; and
- unambiguous environmental cues used by salmon and steelhead to migrate that reflect the magnitude and distribution of those conditions under which anadromous fish populations have evolved in Battle Creek.

1. <u>Construction Schedule</u>

Construction of the Restoration project is anticipated to begin in spring 2006 and end by summer 2009. These dates and those that follow in the project description are current as of the publication of the project ASIP, but could be delayed by one-year increments if the final funding grant is delayed. The current construction schedule for each project site follows:

- North Battle Creek Feeder Diversion Dam—Begin construction in May 2006 and end by September 2007,
- Eagle Canyon Diversion Dam—Begin construction in May 2006 and end by September 2007,
- Wildcat Diversion Dam—Begin construction in July 2006 and end by October 2006,
- South Diversion Dam—Begin construction in August 2008 and end by January 2009,
- Soap Creek Feeder Diversion Dam—Complete construction during August 2008,
- Inskip Diversion Dam and South Powerhouse—Begin construction in June 2007 and end by February 2009,
- Lower Ripley Creek Feeder Diversion Dam—Complete construction during July 2007,
- Asbury Diversion Dam—Complete construction during July 2007, and
- Coleman Diversion Dam and Inskip Powerhouse—Begin construction in May 2006 and end by July 2009.

2. North Battle Creek Feeder Diversion Dam

a. *Fish Ladder*

A new pool-and-chute fish ladder will be constructed near the center of the existing dam, requiring removing the steel portion of the existing steep-pass fish ladder, plugging the west section in the dam, and removing the sluice gate. The existing concrete ladder will be left in place to buttress the dam. A section of the left side of the dam will be reconstructed to accommodate the new fish ladder and sluice gate. The new fish ladder is designed in accordance with NMFS-prescribed parameters in order to function in a failsafe manner for creek flows up to 1,100 cfs, the design flow. The design features a 3-foot-wide contracted weir centered in each of the 8 baffles, sloped weirs on both sides of the contracted weir, and 20-inch-square orifices below the sloped weirs (the left orifice is furnished with a manually operated gate). The new ladder will be 69 feet long (each pool is 8 feet long and 15 feet wide), including a 5-foot-long bay at the top of the ladder where stanchions and flashboards can be installed to isolate the fish ladder for sluicing and debris removal. To facilitate maintenance, a 3-foot-wide movable walkway will spread across the ladder walls and can be positioned as needed along the wall to allow workers to make gate adjustments or remove debris. A catwalk will be provided along the left wall for access. The proposed ladder is approximately 17 feet wide (outer wall to outer wall). A new sluice gate will be installed in the dam immediately to the left (looking downstream) of the new fish ladder. Sensors will be included in the ladder to allow automatic operation of the control gates during high flows. Other sensors will be incorporated into the ladder and fish screen to ensure minimum instream flow requirements are met. Video monitoring equipment will also be included for biological monitoring.

b. *Fish Screen*

The proposed new flat-bar fish screen is designed to pass the maximum potential diverted water right of 55 cfs while meeting NMFS and CDFG salmon and steelhead screening criteria. The existing concrete headworks structure will be modified with a concrete box section to accommodate the new screen configuration. The new screen box will be placed on the left bank to minimize excavation into the canyon wall, will extend about 140 feet downstream of the dam, and will vary in width from about 5 feet to about 15 feet. A 3-foot-wide working platform will be included along the screen for maintenance purposes. A jib crane will be mounted on top of the raised left headwall of the dam to allow equipment and materials to be lifted from the screen deck to the new footbridge.

The total screen length will be 81 feet, consisting of 27 three-foot-square wedge-wire panels. Louvers will be installed behind the screen to provide uniform velocity control along the face of the screen. The screen will include a 7.5-cfs fish bypass. This bypass feature will consist of a 15-inch-wide weir, drop box, and an 18-inch-diameter seamless smooth wall pipe. The fish bypass flow will drop four feet into an energy-dissipating drop box, from which the bypass pipe exits and dumps into the creek. The exit of the bypass pipe into the creek will be free-flowing and set at an elevation such that adult fish cannot enter the bypass pipe. The bypass pipe will then discharge into the creek near the end of the new concrete screen box.

Failsafe fish screen elements are incorporated into the design and operation of the diversion system. The water diversion will be automatically shut off whenever the fish screen fails to meet design or performance criteria until the fish screen is functioning again. The screen will be equipped with stage sensors on both sides of the screen to measure head differential. If a problem is detected, the sensors will trigger an activation of the screen-cleaning mechanism (motorized sweeping brushes), and/or send an alarm. If the problem continues, the diversion will be shut down. Installation of the new screen will require removal of about 130 feet of flume section. The new screen box will transition into the existing flume. This transition section may require reconstruction of a limited number of flume support piers.

c. *Access Road Improvements*

Construction of a new access road will be required for heavy equipment to access the dam during construction and for future daily operation and maintenance needs. The road itself will be about 10 feet wide, with cut slopes affecting a footprint up to 40 feet wide. The road will be paved and will include drainage features that will direct runoff to the stream. At the base of the proposed new road, a permanent, flat landing area will be developed that allows the operation of heavy construction equipment. This landing area will be approximately 30 feet long and 22 feet wide with the outer edge reaching to the edge of the stream. This landing area will be built up with the waterside edge retained by riprap slope protection. The landing area will be paved with asphaltic concrete. At the switchback, a 25-foot spur will facilitate traffic control and turning. The road will be all in cut sections, except at the terminus where the landing is developed. The road will be paved with 6-inch base gravel material overlain by 4-inch asphaltic concrete.

The flat landing area at the terminus of the new road will incorporate a foot access bridge that crosses the creek at the dam. This footbridge will have a traveler rail that can be used to carry heavy loads (*e.g.*, 200-pound screen panels) from the left side of the dam, where the new screen will be located, to the right abutment of the dam, where the road access will allow removal of any mechanical or other features of the new screen and ladder for off-site maintenance.

d. *Construction Considerations*

Construction activities may affect the following areas near North Battle Creek Feeder Diversion Dam:

- **Area within creek channel high-water surface extending about 400 feet upstream of North Battle Creek Feeder Diversion Dam.** Cofferdams and other water control systems will be required to allow construction of the fish ladder and fish screen structures in the dry. The total in-channel area affected will be approximately 21,000 square feet.

- **Area within creek channel downstream of North Battle Creek Feeder Diversion Dam.** This area, extending about 150 feet downstream from the dam, will be disturbed by construction of the fish facilities. The left abutment for the new footbridge will extend up the left canyon wall about 80 feet east of the existing headworks. The total in-channel area affected will be approximately 18,000 square feet.

- **Use of helicopters.** The dam site is in a remote area with no nearby vehicle access. Certain construction equipment and materials, and materials to be permanently removed from the site, may be brought to or removed from the site by helicopter. These materials will be picked up or dropped off at identified staging areas.

All areas temporarily disturbed by construction will be restored to their preproject conditions. Existing roads will be regraded, graveled, and repaired or repaved if necessary. Staging areas will be shaped and graded to prevent ponding of water, planted with suitable grasses and other vegetation, and protected with other erosion control measures, if necessary, to prevent turbid runoff from escaping the site. Areas within the creek channel will be shaped and regraded to eliminate any obstacles to the creek flow or fish passage. Areas permanently disturbed by construction generally do not require restoration. However, permanent cutslopes will be shaped, graded, and vegetated as appropriate to ensure that the slopes remain stable and do not allow turbid runoff to escape the area.

e. *Construction Sequencing and Schedule*

The sequence of construction for the North Battle Creek Feeder Diversion Dam site will be roughly as follows:

- stabilize south canyon face to prevent rockfall hazards to construction workers and facilities;
- construct new access road and landing area;
- build cofferdams and temporary water bypass structures;
- prepare site by demolition of existing facilities, including sluice gate, headworks, and pertinent sections of the dam and by excavation for structures, including removing boulders;
- perform concrete work for new screen and ladder;
- install metalwork for screen and ladders;
- install and test mechanical and electrical systems; and
- remove cofferdams and complete site restoration.

Construction at this site will occur over a 17-month period, with one winter shutdown lasting approximately 7 months. Construction is anticipated to begin in May 2006 and end by September 2007. Water diversions into the feeder canal will be interrupted to allow construction to be performed.

3. Eagle Canyon Diversion Dam

a. *Project Elements*

Proposed features at the Eagle Canyon Diversion Dam site include:

- a vertical-slot fish ladder,
- fish screen,
- powerline relocation,
- access trail improvements, and
- spring collection facilities improvements.

b. *Fish Ladder*

The existing Alaska Steeppass fish ladder will be removed. A section of the south side of the dam, approximately 7 feet deep and 10 feet wide, will be removed where the new fish ladder will be built. A new modified headwall structure will be constructed to accommodate the new ladder as well as the new fish screen. The new modified canal and fish ladder intake area is designed to divert large floating debris away from the headworks so that debris does not collect in the fish ladder and screen system. A floodwall, extending above the 100-year flood event elevation, will be constructed at the upper end of the ladder to protect the new fish passage facilities. The new diversion headworks will include new electric gates, trash racks, electrical controls, and monitoring systems. Sensors will be included in the ladder to allow automatic operation of the control gates in times of high flows. Other sensors will be incorporated into the ladder and creek to ensure minimum instream flow requirements are met. Video monitoring equipment will be included for biological monitoring.

The new vertical slot-type ladder will extend nearly 110 feet downstream from the dam. The combined new canal and ladder will project up to 30 feet into the stream channel and require excavation into the streambed to a depth of between 15 and 20 feet. Above-water blasting of large boulders and bedrock is expected to be necessary to accomplish this excavation. Blasting will be kept to a minimum and charge sizes are not expected to exceed 20 pounds. The ladder is designed to operate properly with a minimum flow of 20 cfs and a maximum flow of 71 cfs, in accordance with agency-prescribed parameters in order to function in a failsafe manner for the creek design flow. Two ladder entrance locations are provided for flexibility of operation during varying tailwater conditions. The entire length of the ladder will be covered with grating to prevent debris from entering the ladder.

c. *Fish Screen*

Construction of a new fish screen will require removing the upstream 100-foot section of canal and replacing it with an enlarged canal section. Above-water blasting is expected to be necessary to accomplish this enlargement of the canal section. Blasting will be kept to a minimum and charge sizes are not expected to exceed 20 pounds. A common wall will be constructed to serve as a canal wall and a side wall for the fish ladder. The new in-canal, flat plate fish screen is designed to divert a flow of up to 70 cfs while meeting screen criteria set by NMFS and CDFG for both salmon and steelhead. The screen system will incorporate a bypass return system designed to operate with a flow of 5 cfs. The bypass system is designed to return the fish to a drop well outside of the ladder turning pool. From the drop well, the fish will be able to enter the turning pool of the ladder through a slot. The screen face will consist of wedge-wire removable panels with a total length of 63 feet. Fourteen fish screen panels measuring 4.5 feet square will enclose the entrance. Louvers will be constructed behind the screen to provide uniform velocity control along the full face of the screen. The screen will have a reinforced concrete foundation with structural steel frames placed at nine-foot intervals. Failsafe fish screen elements similar to those described for the North Battle Creek Feeder screen are incorporated into the design and operation of the diversion system.

d. *Improvements to Spring Collection Facilities*

Historically, PG&E collected spring water originating from numerous locations along the cliff face of the access trail and conveyed it to the Eagle Canyon Canal flume and Tunnel No. 2. For the Restoration project, broken and abandoned pipe collection facilities will be removed and other collection features will be modified to facilitate drainage along the trail and to ensure that spring water is returned to the creek. Some of the existing collection facilities consist of small channels (about 6 inches wide by 3 inches deep) cut along sections of the rock cliff face. These channels will be left in place.

e. *Construction Considerations*

Construction activities may affect the following areas near Eagle Canyon Diversion Dam:

- **Area within the creek channel high-water surface extending about 200 feet upstream of the dam.** Diversion banks and other water control systems will be required for construction of the fish ladder and fish screen structures in the dry. The total in-channel area affected will be approximately 14,000 square feet.

- **Area within the creek channel downstream of Eagle Canyon Diversion Dam.** This area will be disturbed by blasting, excavation, and construction of the fish facilities, which will extend about 180 feet downstream of the dam. Total in-channel area affected will be approximately 18,000 square feet.

- **Use of helicopters.** There is no vehicle access to the dam site. All construction equipment and materials, heavier than can be carried by workers along the footpath, will be transported to and from the site by helicopter. Materials to be permanently removed from the sites will be transported by helicopter and dropped off at identified staging areas.

- **Disposal of materials.** Debris from construction and dam removal activities will be removed from the stream channel and deposited off-site. Debris will be removed to the extent that it will not affect conditions supporting upstream migration of juvenile and adult steelhead and Chinook salmon at minimum flow releases from upstream dams and will not adversely modify spawning (*e.g.*, armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions. Excavated sediments will be temporarily stockpiled in the work zone and then reused as backfill.

f. *Construction Sequencing and Schedule*

The sequence of construction for the Eagle Canyon Diversion Dam will be roughly as follows:

- construct new access road entrance and trail improvements;
- build cofferdams and temporary water bypass structures;
- prepare site by demolition of existing facilities, including fish ladder, headworks, and pertinent sections of the dam and by excavation for structures, including removing boulders;
- construct new headworks;
- perform concrete work for new screen and ladder;
- install metalwork for screen and ladders;
- install and test mechanical and electrical systems; and
- remove cofferdams and complete site restoration.

Construction at this site will occur over a 17-month period, with one winter shutdown lasting approximately 7 months. Construction is anticipated to begin in May 2006 and end by September 2007. Water diversions into the canal will be interrupted to allow construction to be performed.

4. <u>Wildcat Diversion Dam, Wildcat Canal, and Wildcat Pipeline Area</u>

a. *Wildcat Diversion Dam and Appurtenant Facilities Removal*

Wildcat Diversion Dam will be demolished and removed to improve fish passage to the North Fork Battle Creek. Removal of the existing masonry rock structure will involve demolishing the rock/mortar matrix into pieces no larger than one to two feet in size, similar to existing cobble material transported within the river system. The resulting 70 cubic yards of material will be spread over an area extending about 100 feet downstream from the dam site. The material will be placed along and within the creek channel in a manner that will not hinder fish passage or flow. Natural stream flow will distribute the material throughout the downstream river system. The streambed will be restored to preproject conditions.

The existing sediment behind Wildcat Dam will not be removed. No significant quantities of fines exist in the sediments behind the dam, and turbidity is not expected to be a problem. No hazardous material contamination problems are expected in the sediments. These sediments will be left in place for floodflows to distribute the primarily cobble material throughout the river system. It is expected that this material will serve as suitable habitat for aquatic resources.

The masonry intake structure will be broken up, removed from the stream channel, and deposited offsite. There are about 40 cubic yards of material in the intake structure. A thin concrete cap on top of the intake structure contains less than three cubic yards of material. This concrete cap will also be removed and deposited off-site. Debris will be removed to the extent that it will not affect conditions supporting upstream migration of juvenile and adult steelhead and Chinook salmon at minimum flow releases from upstream dams and will not adversely modify spawning (*e.g.*, armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions. Any metalwork associated with the intake structure and dam will be removed and either salvaged by PG&E or disposed of at the nearest approved commercial disposal site.

The steel Alaska Steeppass fish ladder set into the original concrete fish ladder will be removed, cut up, and disposed of at the nearest approved commercial disposal site. The original concrete fish ladder will be broken up into pieces no larger than one to two feet in size. Concrete pieces that contain steel reinforcement will be removed and disposed of at the nearest approved commercial disposal site, and the remaining concrete rubble will be removed to the extent that it will not affect conditions supporting upstream migration of juvenile and adult steelhead and Chinook salmon at minimum flow releases from upstream dams and will not adversely modify spawning (*e.g.*, armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions.

Approximately 5,390 feet of the 24-inch Wildcat Pipeline (total of 5,530 feet) and steel support framework will be removed from the stream channel. Approximately 140 feet of the pipeline and support structure will be left in place to provide the local landowner access across Juniper Gulch. Within this section all concrete piers, steel supports, and miscellaneous metalwork will remain. All other concrete piers along the pipeline alignment will be left in place; however, all timber and steel supports will be removed. The protruding portions of any steel bolts embedded in the concrete piers (these bolts currently attach the steel support structure to the piers) will be cut off flush with the surface and the ends removed. In addition, in a few places along the length of the pipe, the structure is anchored into the canyon wall; all of these anchor bolts will be cut off at the rock surface and the ends removed.

Wildcat Canal will be filled in except for specific sections, which will be left unfilled, either at the request of the landowners or as a means to control natural drainage that enters the canal from upslope. Captured drainage water will be conveyed to selected discharge points. Import of fill materials will be minimized. Any imported materials that might be needed will be obtained from excess excavated materials (materials that will otherwise be disposed of on-site) from other work sites, such as at the Coleman Diversion Dam/Inskip Powerhouse site (connector pipeline and bypass pipeline excavation).

b. *Construction Considerations*

Construction activities may affect the following areas near Wildcat Diversion Dam, Wildcat Canal, and pipeline:

- **Wildcat Diversion Dam**. Work required below the canyon rim for the removal of Wildcat Diversion Dam will be limited to an approximate 100-foot width across the canyon and extend 100 feet downstream from the dam and 250 feet upstream of the dam. The total area affected will be approximately 35,000 square feet.

- **Wildcat Pipeline**. Work required for the removal of the Wildcat Pipeline will be limited to the 5,500-foot-long pipeline corridor that averages 20 feet wide. The total area affected will be approximately 110,000 square feet.

- **Wildcat Canal**. Work required for the abandonment of the Wildcat Canal will be limited to a 70-foot-wide corridor along the portion of the canal from the pipe outlet box to 440 feet west of Wildcat Road, for a total of 3,200 feet. The total area affected will be approximately 224,000 square feet.

- **Use of helicopters**. Both the dam site and pipeline alignment are in remote areas with no nearby vehicle access. All construction equipment and materials, heavier than can be carried by workers along the footpath, will be transported to and from the site by helicopter. Materials to be permanently removed from the sites will be transported by helicopter. These materials will be picked up or dropped off at identified staging areas.

c. *Construction Sequencing and Schedule*

The sequence of construction for the Wildcat Diversion Dam will be roughly as follows:

- cut Wildcat Pipeline about 100 feet downstream of dam to allow draining of reservoir area through outlet,

- remove sluiceway gate to lower reservoir level further,

- construct upstream cofferdam,

- remove old fish ladder and notch dam to streambed grade to further reduce reservoir level,

- remove remainder of dam,

- remove last section of walkway (metalwork),

- remove pipeline concurrently with dam removal activities,

- fill in Wildcat Canal and complete remaining reconfiguration of canal for drainage and access road concurrently with dam removal activities, and

- remove upstream cofferdam and complete site restoration activities.

Construction at this site will occur over a 4-month period. Construction is anticipated to begin in July 2006 and end by October 2006.

5. South Diversion Dam and South Canal Areas

a. *South Diversion Dam and Appurtenant Facilities Removal*

South Diversion Dam will be completely removed, including both the overflow section and the non-overflow sections, with special consideration for some of the intake structure and appurtenant facilities as described below. The steel plate cap and steel bin-wall components of the dam will be removed. The gravel and cobble material filling the bins will be removed and spread downstream of the dam over about a 100-foot distance. All concrete will be removed from the stream channel. Concrete containing steel reinforcement will be disposed of off-site in an approved commercial disposal site. Concrete not containing steel will be disposed of off-site or broken up into 1- to 2-foot fragments and buried in portions of South Canal.

The reservoir behind the dam is largely filled with sand, gravel, cobbles, boulders, and debris so that the depth of water averages between two and three feet below the dam crest. Most of the material is cobble size. These sediments will be left in place and allowed to be distributed downstream by natural flows. It is anticipated that only one normal flood season will be required to distribute these materials downstream. A pilot channel will be excavated in the sediments 500 feet upstream from the dam site to facilitate sediment flushing and to ensure that fish passage is adequate. The pilot channel will have a bottom width of approximately eight feet and side a slope angle of approximately one foot of depth for every three feet of width. The bottom slope of the channel will have one foot of drop for every 8 to 10 feet of length. Some of the material excavated for the pilot channel may be used to fill portions of South Canal. The remaining material excavated for the pilot channel will be spread in the river channel upstream of the dam.

Portions of a reinforced concrete intake structure to South Canal will be retained on the right abutment of the dam to allow the gate to Tunnel No. 1 to be welded closed. The radial sluice gate on the right abutment will be removed and either salvaged or disposed of off-site. The South Canal intake structure trashrack and slide gate operator will be removed. The steel denil-type fish ladder that is attached to the downstream face of the overflow crest structure will be removed and either salvaged or cut into sections and disposed of off-site. Miscellaneous handrails, ladders, and metal walkways associated with the canal intake structure or along the trail leading to the structure will be removed and salvaged or disposed of off-site.

b. *South Canal*

Activities associated with the decommissioning of the South Canal will primarily occur in upland areas and are not expected to affect listed salmonids or the aquatic ecosystem.

c. *Construction Considerations*

Construction activities may affect the following areas near South Diversion Dam and the South Canal:

- **Area within creek channel high-water surface, extending about 500 feet upstream from South Diversion Dam**. Construction of a pilot channel for the excavated sediments, redistribution of the reservoir sediments within the areas upstream and downstream of the dam, and excavation of sediments to allow dam removal will affect this area. The total area affected will be approximately 72,000 square feet.

- **Area within the creek channel downstream of South Diversion Dam, including part of the access ramp on the downstream right creek bank.** This area will be disturbed by equipment crossing the creek to reach the dam removal area. The total area affected will be approximately 96,000 square feet.

- **Area along the left creek bank**. This area will be disturbed by regrading and by equipment crossing the creek to reach the dam removal area. The total area affected will be approximately 18,000 square feet.

- **Use of helicopters**. The dam and canal sites are in remote areas with limited vehicle access. Certain construction equipment and materials and materials to be permanently removed from the site may be brought to or removed from the sites by helicopter. These materials will be picked up or dropped off at identified staging areas.

d. *Construction Sequencing and Schedule*

Activities at the South Diversion Dam site will be accomplished in roughly the following order:

- close off diversion at South Diversion Dam by sealing inlet portal,

- remove any mechanical features to be salvaged or disposed of from the dam,

- remove South Diversion Dam,

- remove South Canal features concurrently with the dam removal, and

- complete site cleanup and restoration.

Construction at this site will occur over a 5-month period. Construction is anticipated to begin in August 2008 and end in January 2009.

6. Soap Creek Feeder

a. *Soap Creek Feeder Diversion Dam*

Soap Creek Feeder Diversion Dam will be removed. All mechanical equipment will be either salvaged or disposed of off-site. Dam materials not containing steel will be broken up into pieces no larger than 1 to 2 feet in size, hauled to the nearest South Canal open-channel site, and buried. These materials may be temporarily stockpiled until South Canal flows cease. Materials containing steel will be removed and disposed of off-site. The dam will be removed to the existing streambed grade. The dam retains a minor volume of sediments. A pilot channel will not be excavated. Natural creek flows will be sufficient to distribute the materials downstream. Cold spring water entering Soap Creek above the dam will be allowed to continue downstream of the dam site.

b. *Soap Creek Appurtenant Facilities*

The pipeline, which extends 291 feet downstream to a junction box (including a stilling well, a venturi flume, and a 27-foot-long metal flume) will be removed from the site. The concrete piers that support the pipeline will be removed and disposed of off-site.

c. *Construction Considerations*

Construction activities may affect the following areas near Soap Creek Feeder Diversion Dam:

- **Staging area for the removal of Soap Creek Feeder Diversion Dam.** Work for the dam removal will be staged from a small area above the right abutment of the dam. This area and the access footpath leading down to the dam will be graded and shaped to establish safe access. The access path corridor will be minimized to about 20 feet wide. The total area affected will be approximately 5,000 square feet.

- **Area within the creek channel upstream and downstream of Soap Creek Feeder Diversion Dam.** This area will be disturbed during dam removal. The affected area will extend about 60 feet upstream and about 40 feet downstream from the dam and will be 40 feet wide, bank to bank. The total area affected will be approximately 4,000 square feet.

d. *Construction Sequencing and Schedule*

Once the diversion gate is closed on Soap Creek Feeder Diversion Dam, removal of both the dam and appurtenant facilities will proceed concurrently. The sluice gate section within the dam will be left in place until the end of construction to facilitate diversion of the creek water. Once the largest portion of the dam is removed, this final section will be taken out. Construction at this site will occur over a one-month period. Construction is anticipated to occur during August 2008.

7. Inskip Diversion Dam/South Powerhouse

a. *Fish Ladder*

The proposed Half Ice Harbor fish ladder will be located on the north (right) bank of South Fork Battle Creek below Inskip Diversion Dam. Beginning at the entrance pool, the ladder will climb the northern stream bank in the downstream direction, roughly paralleling the streamflow, for a distance of about 200 feet, where it will turn perpendicular to the creek and climb the remaining elevation up the stream bank slope to tie into the Inskip Canal.

The exit pool of the fish ladder will be located immediately downstream of the fish screen and adjacent to the gate structure on Inskip Canal. Video monitoring equipment will be installed at the outlet pool for biological monitoring. A bypass channel will be provided to divert water around the fish screen, if needed. Auxiliary water will be collected from behind the fish screen, piped to the ladder entrance, and diffused up through the grating in the floor of the entrance pool. The design flow of the ladder is 39 cfs and will be supplemented by up to 131 cfs of auxiliary water.

The ladder will have pools 9 feet wide by 10 feet long and have both weir and orifice flow between consecutive pools. The weirs will be 5 feet wide, and the orifices will be 24 inches high by 24 inches wide. There is sufficient inflow to the site for the ladder to operate without adjustment in all, but the very driest, of years. If creek flows drop to the 20- to 25-cfs range, the orifices may need to be partly closed to maintain proper ladder hydraulics. Sensors will be included in the ladder to allow automatic operation of the control gates during high flows. Other sensors will be incorporated into the ladder and fish screen to ensure minimum instream flow requirements are met.

The creek bed will be excavated to a depth of approximately five feet to develop a pool at the ladder entrance. Some bedrock on the creek bank opposite the ladder may also need to be excavated to maintain desirable creek hydraulics. The top of the entrance pool will be covered with grating to prevent debris from being deposited within the ladder during large flow events.

An access road will be constructed on the north (right) creek bank to provide access for operation and maintenance of the fish ladder and screen. The new 12-foot-wide road will originate at a new parking area adjacent to the fish screen, continue upstream along the right bank of the creek, and terminate at South Powerhouse, where it will connect to the existing access road. A prefabricated railroad car bridge will be constructed across Inskip Canal, just downstream of the new fish screen structure, for access to the fish ladder and entrance pool via a lower service road. Originating at the railroad bridge, the service road will run along the fish ladder and terminate at stream level near the entrance pool. Fill for the service road will extend approximately 50 feet toward the creek, measured from the south ladder wall. An upper service road, approximately 160 feet long, will tee off the lower service road, cross over the fish ladder, and terminate at the sluiceway. The road will provide access to the top of the fish ladder entrance chamber so staff can operate and maintain the entrance gates and install and remove stoplogs.

The entire northern stream bank slope, from the entrance pool roughly 50 feet below the dam downstream to about 1,100 feet below the dam, will be affected by construction activities.

The metalwork will be removed from the existing Alaska Steeppass fish ladder. The concrete portion of the original pool and weir ladder will remain in place, but the upper end will be blocked so upstream migrants are no longer attracted to the ladder.

b. *Fish Screen*

The proposed 121.5-foot-long flat-plate fish screen will be constructed in Inskip Canal extending downstream from a point beginning about 190 feet below the diversion headworks. The fish ladder exit will be just downstream of the screen bypass. The proposed fish screen will have a capacity of 220 cfs under normal operating conditions. The water depth on the screen will be maintained at six feet to seven feet depending on the creek stage. The base of the screen will be set six inches above the canal bottom to allow for some sediment collection without affecting the screen operation. Louvers will be installed behind the screen to provide uniform velocity control along the face of the screen. Sweeping velocities are expected to be 3 feet per second, resulting in an estimated time of 41 seconds for the fish to move past the screen. The framing system will support a removable, stainless steel, wedge-wire or equivalent screen which meets CDFG and NMFS fish screen criteria. A motorized sweeping-type brush assembly will clean the entire screen face. Multiple independent cleaning brush systems will be required to cover the full length of the screen within durations satisfying the criteria specified by CDFG and NMFS. Failsafe fish screen elements similar to those described for the North Battle Creek Feeder screen are incorporated into the design and operation of the diversion system.

Construction of the fish screen will require the placement of a cofferdam within Inskip Canal just below the construction zone for the screen. The location of this cofferdam is along the alignment of the proposed permanent prefabricated bridge canal crossing. A construction access road will be maintained across this cofferdam during construction. Construction of this cofferdam will allow operation of the completed bypass tunnel and continued power generation at downstream powerhouses while construction of the fish screen and ladder proceeds.

To meet velocity requirements across the fish screen, the Inskip Canal cross section will require widening, and the capacity of Tunnel No. 1 will need to be increased. This existing tunnel has very little overburden cover over it, leading to concerns that any attempt to increase the diameter of the tunnel to provide additional capacity will lead to its collapse. Consequently, Tunnel No. 1 will be converted to an open-channel section to provide the additional capacity. The canal cross section will be realigned approximately 40 feet to accommodate the new section. This widened section will be tied into the existing canal cross section immediately downstream of the proposed ladder and screen.

c. *Headworks*

The existing headworks structure, located near the right bank just upstream of the tunnel entrance, will be removed and replaced with a new structure. The new concrete structure will be cast against the rock abutment on one side and anchored to the existing dam on the other side. The structure will be just over 31 feet long and 20 feet wide, with a rectangular flow area 16 feet wide. The headworks entrance will be protected by a trashrack and will house two electric gates mounted side by side. Headworks equipment will include electrical controls and monitoring systems to allow automatic operation of the gates, in coordination with other flow regulation equipment at the site.

d. *Sluiceway*

The existing sediment basin is located just upstream of the future fish screen and includes a radial gate structure. The radial gate will be repaired and a new sluiceway will be added downstream of the radial gate to convey water over the new fish ladder and into the creek. The sluiceway will be constructed on fill and also supported by piers. The sluiceway and radial gate will be used periodically to remove accumulated sediment. The improvements to the radial gate at Inskip Diversion Dam will be similar and will also include replacing damaged steel members.

e. *Inskip Canal Wasteway*

An overflow wasteway in the Inskip Canal will be provided in the area between the South Powerhouse tailrace connector tunnel outlet and the fish screen. The wasteway will consist of a 100-foot-long concrete overflow box and pipe set in the southwestern Inskip Canal embankment. Excess water in the canal will overflow a lowered weir section into a concrete collector box. This collector box will feed the excess water into a pipeline that discharges into the South Fork. The wasteway structure will have a capacity of 105 cfs. This wasteway will protect Inskip Canal from an uncontrolled overtopping that could occur when an excessive amount of water is discharged into the canal from the combined flows of the South Powerhouse tailrace and the penstock bypass, while supplemental diversions were being made at Inskip Diversion Dam through the fish screen. The Inskip Canal wasteway will ensure that any flows that exceed the capacity of Inskip Canal can be removed from the canal in a controlled manner. The discharged water will be a mixture of North and South Fork water but excess flows will be of short duration.

f. *South Powerhouse Tailrace Connector Tunnel*

The proposed tailrace connector tunnel will allow diversion of South Powerhouse tailrace flows to Inskip Canal. The connector tunnel consists of a new 1,200-foot-long excavated tunnel in the northern slope paralleling the South Fork. The tunnel portal cut will be about 34 feet high and 50 feet wide. The concrete headworks structure constructed at the inlet portal will incorporate an 8- by 7-foot radial gate for operation and maintenance purposes. The inlet portal headworks will also incorporate stoplog slots to act as a backup to the radial gate.

g. *South Powerhouse Tailrace Channel Modification*

The South Powerhouse tailrace channel will be modified to prevent mixing of North Fork Battle Creek water with South Fork water. The proposed modification will continue to use the natural drainage channel to bypass waste flows past the powerhouse to the tailrace when the powerhouse or penstock is shut down. The tailrace will be closed off, and instead of being allowed to enter the South Fork Battle Creek, the water will be conveyed into the new connector tunnel (described above). The proposed South Powerhouse tailrace modification incorporates the modifications to the peninsula and existing tailrace channel that are necessary to divert flows into the proposed new bypass tunnel.

h. *Construction Considerations*

Construction activities may affect the following areas near the South Powerhouse:

- **Peninsula area.** This area, adjacent to the powerhouse, will be heavily disturbed by construction activities for the following new features: an access road, a tailrace dike, creek-side riprap armoring, temporary small cofferdams in the creek and tailrace, an access ramp into the tailrace, large-diameter culverts through the peninsula, and associated riprap downstream of the culverts and tailrace dike. The area will extend to 20 feet south of the south bank of Battle Creek and to the uphill-side waterline (north side) of the tailrace. The total area affected will be approximately 122,000 square feet.

- **Low-water crossing area.** This crossing area, which allows access to the left (south) side of Inskip Diversion Dam, may be widened and vegetation cleared to a 20-foot-wide corridor for a distance of approximately 250 feet. The existing crossing has a concrete apron within the flow channel and is suitable for the lower flows normally encountered. Because of the required cessation of flows in the South Canal, the flows in Battle Creek will be increased. Temporary culverts may be installed to improve safety and increase the duration of use of this crossing area. The crossing is necessary to establish access to the right side of Inskip Diversion Dam in order to construct the fish ladder exit (headworks modifications). The total area affected will be approximately 5,000 square feet.

- **Area encompassing the new tunnel downstream portal area, construction access ramp, and other features associated with the new tunnel from the Tunnel No. 2 inlet to the existing footbridge and from the left edge of the canal bank (looking downstream) upslope to the limits of the access road.** The total area affected will be approximately 24,000 square feet.

- **Area extending from the preceding 24,000-square-foot area downhill to the middle of Battle Creek.** Features to be constructed in this area will include the wasteway inlet structure, its outfall pipe, and the levee bank reinforcement between the fish screen and the Tunnel No. 2 inlet. The total area affected will be approximately 37,000 square feet.

- **Area encompassing the fish facilities downstream of Inskip Diversion Dam to the two preceding areas (24,000 square feet and 37,000 square feet) and extending 20 feet south of the south bank of the creek.** This area will include the fish ladder, fish screen, associated access roads, ramps, bridges, and parking areas and will extend to within 70 feet downstream of the dam. The existing fish ladder, which encompasses approximately 700 square feet of this area, will be partly demolished (metalwork removed and disposed of) and plugged. Much of the area not permanently occupied by the new features will be used by the contractor for staging, stockpiling, and other temporary uses. This area will be required to allow the construction workers and equipment access to the new and existing fish ladder work sites. The total area affected will be approximately 137,000 square feet.

- **Area encompassing the temporary access road on the south side of Battle Creek.** This area will encompass the diversion works that will be built to allow construction of the headworks modifications on the right abutment of Inskip Diversion Dam (for the fish ladder exit). A 20-foot-wide path will be cleared and graded from the low-water crossing described above, downstream to the vicinity of the dam. The diversion works will consist of an earthen cofferdam enclosing the headworks area, an access road embankment from the left side of the creek to the cofferdam, culverts under this access road to pass the creek flow through, riprap armoring to protect the temporary embankments from creek erosion effects, and excavation within the creek to channel the diverted creek flow toward Inskip Diversion Dam. The diversion works activities within the creek will extend about 200 feet upstream of the dam. All of these features will be removed at the completion of the headworks modifications and the areas restored to their pre-construction condition. The total area affected will be approximately 46,000 square feet

i. *Construction Sequencing and Schedule*

Construction activities at the Inskip Diversion Dam/South Powerhouse site will require extensive coordination. The sequence of construction at this site will roughly follow this order:

- prepare upper plateau access road;
- construct peninsula culvert and tailrace dike;
- construct lower site access road after crossing peninsula and tailrace dike;
- install temporary tailrace cofferdam;
- construct a temporary cofferdam within Inskip Canal upstream of the bypass tunnel outlet portal, and install a fish screen and ladder; and
- complete site restoration.

Construction at this site will occur over a 21-month period, with one winter shutdown lasting approximately 7 months. Construction is anticipated to begin in June 2007 and end by February 2009.

8. Removal of Lower Ripley Creek Feeder Diversion Dam and Appurtenant Facilities

Lower Ripley Creek Feeder Diversion Dam and all appurtenant facilities will be removed. The diversion dam is a very small structure and can be easily removed using an excavator with a hoe-ram or similar construction equipment. All waste concrete will be removed from the site. Cold spring water entering Ripley Creek above the dam will be allowed to continue downstream of the dam site.

The diversion canal extends 384 feet downstream from the dam to the Inskip Canal. The canal will be filled in using the existing canal bank materials. The existing canal bank will be excavated to a depth that fills in the canal and reestablishes the original ground slope as near as possible. The area will be graded to prevent ponding and allow cross-slope drainage to continue downslope. The bank excavation will be adjusted locally to minimize affects to the root zones of adjacent trees. Where the feeder canal discharges into Inskip Canal, the transition will be shaped and armored with riprap to ensure stability of the canal. The concrete measuring flume located in the canal just downstream of the dam will be removed and disposed of off-site. All waste steel, mechanical, and miscellaneous items will be removed and disposed of off-site.

a. *Construction Considerations*

Construction activities may affect the following areas near Lower Ripley Creek:

- **Lower Ripley Creek**. During construction at the South Powerhouse, water from the Cross Country Canal will be diverted into Lower Ripley Creek to bypass the water around the South Powerhouse construction zone. During this period, this reach of Lower Ripley Creek will convey uncharacteristic high flows (50 cfs versus the average flow of 3 cfs) for up to several months. While this flow level is uncharacteristic, it is not unprecedented. Lower Ripley Creek has been known to flow at several hundred cfs during high winter flows. The water diverted from the Cross Country Canal will be diverted at Lower Ripley Creek Feeder Diversion Dam to the Inskip Canal via the present Feeder Canal (modified as described below). The length of affected creek channel from the Cross Country Canal to Lower Ripley Creek Feeder Diversion Dam will be approximately 16,100 feet. The distance from Lower Ripley Creek Feeder Diversion Dam to South Fork Battle Creek is 4,500 feet. The total length of Lower Ripley Creek that will be affected is 20,600 feet.

- **Lower Ripley Creek Feeder Diversion Dam**. Removal of Lower Ripley Creek Feeder Diversion Dam will affect a 6,000-square-foot area. Prior to the period of diverted flows described above, the Feeder Canal will be widened and deepened and its banks raised so that it can safely accommodate these higher, temporary flows. The final removal of the Feeder Canal will affect a total area of approximately 14,000 square feet.

b. *Construction Sequencing and Schedule*

Construction at Lower Ripley Creek Feeder Diversion Dam will involve diverting flow back into Ripley Creek followed by removing the dam and backfilling the diversion channel. Construction at this site will occur over a period of two weeks for the temporary canal diversion and an additional two weeks for the final removals. Construction is anticipated to occur during July 2007.

9. <u>Coleman Diversion Dam/Inskip Powerhouse</u>

a. *Inskip Powerhouse Tailrace Connector*

The Inskip Powerhouse tailrace will be reconstructed to prevent powerhouse discharges from entering directly into the South Fork Battle Creek. The proposed tailrace reconstruction includes:

- installing a bolted-on slide gate or bulkhead at the end of the existing tailrace walls to close off the tailrace from the creek;

- constructing a gate structure through the right tailrace wall that will convey the discharge from the powerhouse to an 84-inch pipeline leading to the Coleman Canal; and

- constructing an outlet transition to discharge water from the 84-inch pipeline into the Coleman Canal.

The channel and gate structure will facilitate continuation of power generation during construction of the tailrace connector pipeline. The 660-foot-long, 84-inch tailrace connector pipeline will be buried, terminating at an outlet transition structure equipped with a slide gate or bulkhead for operation and maintenance purposes. The outlet transition structure will discharge the tailrace flow into the new Coleman Canal entrance channel.

b. *Coleman Diversion Dam and Appurtenant Facility Removal*

The masonry dam overflow section with concrete overlay will be removed. The dam construction incorporates rock cobbles embedded in a mortar matrix and will be removed from the site to the extent that it will not affect conditions supporting upstream migration of juvenile and adult steelhead and Chinook salmon at minimum flow releases from upstream dams and will not adversely modify spawning (*e.g.*, armoring) or rearing habitat. A qualified fish biologist will inspect the stream channel and confirm the restoration of habitat conditions.

The following appurtenant structures will also be removed:

- radial sluice gate structure,

- Alaska Steeppass fish ladder and concrete,

- reinforcing steel and miscellaneous metalwork, and

- original concrete fish ladder structure.

The rock masonry wall that forms the left embankment of the Coleman Canal will be retained, including the weir wall that extends approximately 30 feet upstream from the dam parallel to the creek flow. The curved wing wall that extends from the metal grating footbridge out toward the creek will also be retained. The masonry wing wall that extends from the curved wall will be partially removed to allow construction of the newly configured entrance channel to the canal. The area that lies behind the weir wall that extends upstream from the dam and parallels the creek flow will be backfilled and riprapped. Blasting will be necessary for construction of portions the penstock bypass and the tailrace connector, which are located on solid bedrock upstream of Coleman Diversion Dam, approximately 100 feet from the creek channel. Blasting will be kept to a minimum and charge sizes are not expected to exceed 20 pounds.

c. *Sediment Management*

Sediment behind the existing dam will be left in place to be distributed by natural flows. A pilot channel will be excavated to approximately 500 feet upstream of the dam site to facilitate mobilization of sediments in the stream channel and fish passage. The pilot channel will have a bottom width of eight feet and side slopes of 3:1 (one foot of depth for every three feet of width on sides of channel). The bottom slope of the pilot channel will be approximately 42:1 (1 foot of drop for every 42 feet of length). Material excavated for the pilot channel will be spread in the river channel upstream of the dam. Under low flow conditions, the pilot channel geometry will provide a sufficient depth of water so as not to pose a barrier to fish passage. Under typical winter flow conditions, sediments will quickly begin to erode and distribute downstream.

d. *Construction Considerations*

Construction activities may affect the following areas near the Inskip Powerhouse:

- **The area upstream of Coleman Diversion Dam below the high-water mark.** This area will be affected by the excavation and redistribution of the sediments that are presently impounded. A pilot channel will be excavated and portions of the materials placed in spoil banks within the creek channel and left to be distributed by the natural flows. Total area affected will be approximately 69,000 square feet.

- **Closure wall.** The area that will be disturbed to construct the tailrace connector pipeline in the vicinity of the creek will be minimized to protect the riparian corridor and to protect the trees in the upland area. Some work within the creek in the vicinity of the powerhouse tailrace outlet area will be necessary to construct the closure wall and riprap slope protection. Blasting for structure excavations will occur on the right bank beyond the dam, within about 100 feet of the creek channel. Total area affected will be approximately 141,000 square feet.

Construction for the project is expected to last 39 months and is anticipated to begin May 2006 and end in July 2009.

10. Asbury Pump Diversion Dam on Baldwin Creek

Proposed restoration actions in Baldwin Creek include a minimum instream release of 5 cfs from Asbury Diversion Dam. Cold spring water entering Baldwin Creek from Darrah Springs above the dam would be allowed to continue downstream of the dam site. PG&E would be required to operate a remote-sensing device to continuously measure and record total flow and stage fluctuations at the diversion dam during all operations to verify compliance with applicable provisions under the FERC license.

The instream release would be accomplished by fitting three or four existing bays with flow-measurement weirs, which would replace the flashboard weirs mounted on the crest of the dam. To ensure that the minimum flow of 5 cfs is released over the flashboards, PG&E's Asbury Pump Station would continuously monitor the reservoir water level behind the dam. The pump station has an electronic controller that receives input from water-level sensors that transmit the water surface elevation of Asbury Pond behind Asbury Diversion Dam. The pump station then maintains the pond water surface elevation by discharging the correct amount of water. This ensures a constant release rate over the flashboards. Under flood conditions, the extra water that cannot be pumped simply spills over the flashboards and results in an increased release over the 5 cfs required.

In order to prevent anadromous fish from passing over Asbury Diversion Dam and potentially transmitting diseases to the Darrah Springs Fish Hatchery, the dam structure and operations will be modified. To minimize the risk of fish passing over Asbury Diversion Dam, a 6- to 8-inch-high concrete or steel plate cap will be attached to the existing crest of the dam. The weir cap will be flush with the upstream side of the dam and will extend to the downstream-most walkway support posts. The cap will be constructed with a 2% minimum slope, and will extend across the entire face of the dam except for the area adjacent to the sediment-pass-through control structure. Installation of the cap will require the construction of a temporary upstream cofferdam and excavation of reservoir sediments at the upstream face of the dam. New concrete walls will be required on the abutments to prevent fish passage during large flood events.

To eliminate potential jump pools below the dam crest, two existing scour holes near the downstream toe of the dam will be covered by a concrete apron that will extend across the face of the dam and approximately 12 feet downstream. Together, the cap and the apron are intended to prevent fish from jumping over the dam, with the cap serving as a jump barrier and the apron eliminating jump pools below the dam.

Under current operating conditions, a 10-foot-wide flashboard spill gate is periodically opened completely to allow sediments that accumulate behind the dam to pass through. Under future conditions, the sediment-pass-through gate operations will be discontinued to prevent fish from passing the dam during sluicing operations. Instead, sluicing will be accomplished through a 36-inch culvert pipe that will be attached to an existing slide gate on the dam. The outlet pipe will extend between 75 and 100 feet downstream. The pipe will be constructed of a suitable material (e.g., reinforced concrete, steel, or high density polyethylene), will be properly supported with concrete saddle supports, and will not have any internal corrugations. The pipe will be placed at the steepest angle that the channel geometry allows. Due to high velocity flow in the pipe, it is expected to serve as a velocity barrier to upstream passage.

a. *Construction Considerations*

Construction activities may affect the following areas near Asbury Diversion Dam:

- **Upstream modifications.** Installation of the cap on the crest of the dam, construction of a temporary upstream cofferdam and excavation of reservoir sediments at the upstream face of the dam will affect approximately 4,000 square feet.

- **Downstream modifications.** Construction of the concrete apron and the 36-inch sluicing pipe will affect approximately 3,000 square feet.

- **Access trail.** The access trail between the diversion dam and the enclosure will involve clearing vegetation and minor hand excavation. Total area affected will be approximately 1,200 square feet.

B. Operational Modifications

1. Adaptive Management

Adaptive management is an integral component of the Restoration project. Under adaptive management, restoration activities will be monitored and analyzed to determine whether they are producing the desired results (*i.e.*, properly functioning habitats).

As implementation proceeds, results will be monitored and assessed. If the anticipated goals and objectives are not being achieved, adjustments in the restoration strategy or actions will be considered through the draft *Battle Creek Salmon and Steelhead Restoration Project Adaptive Management Plan* (Adaptive Management Plan) which has been developed consistent with relevant CALFED guidelines (CALFED 1999). The Water Acquisition Fund and Adaptive Management Fund, which are elements of adaptive management, will provide funding for potential changes to Restoration project actions that result from the application of the Adaptive Management Plan.

2. Water Rights

PG&E's water diversion rights associated with all dams removed in the Restoration project will be transferred to CDFG. CDFG agrees that the transferred water rights will not be used to increase prescribed instream flow releases above the amounts specified in the MOU or developed pursuant to the Adaptive Management Plan. It further agrees that the rights will not be used adversely against remaining hydroelectric project upstream or downstream diversions until the FERC license is abandoned, at which time the limitation regarding transferred water rights will no longer apply.

PG&E agrees that it will not use its riparian rights tied to lands associated with components of the Restoration project to decrease prescribed instream flow releases below the amounts specified by the Restoration project or developed pursuant to the Adaptive Management Plan. PG&E agrees that any deed transferring such riparian land or rights will contain this restriction.

PG&E and CDFG will jointly file a petition with the SWRCB pursuant to Section 1707 of the California Water Code to dedicate to instream uses the water diversion rights associated with all removed dams in the Restoration project.

C. Proposed Conservation Measures

The following conservation measures and environmental commitments have been incorporated into the project plan and will be implemented before and/or during the Restoration project construction activities.

1. <u>Develop and Implement a Worker Environmental Education Program</u>

Construction contractor and subcontractor personnel will be required to participate in and comply with an environmental education program provided by Reclamation. This program will include, but is not limited to: (1) awareness regarding Federal, State, and local environmental laws and regulations and permits, as well as the penalties for noncompliance with environmental requirements and conditions; (2) threatened and endangered species and special-status species, as well as their habitats; (3) cultural resource sites; and (4) environmental protection measures, mitigation, compensation, and restoration. A member of the contractor's management staff shall participate in the training sessions to discuss the contractor's environmental protection plans. Upon completion of each training session, each employee will be required to sign a statement indicating that he/she has received the training.

2. <u>Designate Work and Exclusion Zones</u>

Reclamation and/or the construction contractor will ensure that construction equipment and associated activities will be confined to the designated work zone in areas that support sensitive resources. Construction equipment will be confined to a designated work zone (including access roads) at each project site. Prior to construction, the work zone will be clearly staked and flagged.

Exclusion zones will be delineated in the field by a qualified biologist using global positioning system units to measure distances from sensitive resources. These zones will be demarcated by orange construction fencing or along access roads with stakes and ropes. All fences will have signs attached that identify each area as an *Environmentally Sensitive Area*. The fencing will be installed before construction activities begin and will be maintained throughout the construction period. The following paragraph will be included in the construction specifications for environmentally sensitive areas:

"The Contractor's attention is directed to the areas designated as Environmentally Sensitive Areas. These areas are protected, and no entry by the Contractor for any purpose will be allowed unless specifically authorized in writing by the Bureau of Reclamation. The Contractor shall take measures to ensure that Contractor's employees do not enter or disturb these areas, including giving written notice to employees and subcontractors."

During the environmental education program, construction personnel will be informed about the importance of avoiding ground-disturbing activities outside the designated work zone. During construction, the construction monitors and resource monitors will ensure that construction equipment and associated activities avoid any disturbance of sensitive resources outside the designated work zones. Environmental monitors will conduct surveys as appropriate for threatened and endangered species and special-status species. The following measures will also be employed:

- use and storage of construction equipment, including helicopters, will be confined to within the designated contractor use area limits,
- existing roads and access points will be used to the extent possible to minimize disturbance to wildlife and their habitats,

- excavating, filling, and other earthmoving within the contractor use areas will be done gradually to allow wildlife to escape in advance of machinery and moving soils,

- riparian vegetation or wetlands temporarily affected by loss or reduction of water supplies as a result of construction activities will be provided with replacement water supplies,

- staging areas, borrow material sites, parking locations, stockpile areas, and storage areas will be located outside of environmentally sensitive locations and will be clearly marked and monitored.

3. <u>Timeframes for Instream Work</u>

Specific timeframes or work windows for instream work and other activities that could harm anadromous fish have been established for the Restoration project. These work windows are intended to allow timely completion of construction activities in order to minimize the duration of construction impacts. In addition, the work windows will prohibit these harmful activities from occurring during the periods when listed salmonids are most likely to be negatively impacted (spawning and incubation periods). Table 2 below shows the specific work windows for each instream construction area associated with the Restoration project. Note that the sites that have instream work windows that run through October are all above impassible dams, and listed salmonids are not expected to be affected by construction activities at these sites.

Table 2. Proposed Instream Construction Schedule for Each Project Site for the Restoration Project

Restoration Project Site	Instream Construction Schedule[a]
North Fork Battle Creek	
North Battle Creek Feeder Diversion Dam	May 1—November 1[b]
Eagle Canyon Diversion Dam	May 1—September 1[c] (for higher impact work, e.g., blasting, percussion driving, and excavation) May 1—November 1[b] (for lower impact work, including cofferdam removal)
Wildcat Diversion Dam	May 1—September 1[c]
South Fork Battle Creek	
South Diversion Dam	May 1—November 1[b]
Soap Creek Feeder Diversion Dam	May 1—November 1[b]
Inskip Diversion Dam	May 1—November 1[b]
Lower Ripley Creek Feeder Diversion Dam	May 1—November 1[b]
Coleman Diversion Dam	May 1—September 1[c]
Mainstem of Battle Creek	
Asbury Diversion Dam	May 1—November 1[b]

Notes:

[a] The instream construction schedule represents the time when construction is permitted to occur within the ordinary high water mark for the creek. The schedule does not represent the full duration when construction will actually occur in the creek; instream construction varies for each project site and may require less time than that presented above.

[b] May 1—November 1 corresponds to the low flow season. May 1 represents the earliest date for instream construction to begin, depending on stream flow conditions. Should May experience high flows, instream construction will not begin until after high flows have subsided. November 1 is the latest date for instream construction to end and is also dependent on stream flow conditions.

[c] May 1—September 1 corresponds to the season when instream construction is permitted to occur to avoid construction impacts on spawning and incubating anadromous fish.

4. Implement a Fish Rescue Operation

Stream channel segments may be isolated from the streamflow during construction. Reclamation, in consultation with NMFS and CDFG, will ensure that a fish biologist is on-site to implement a fish rescue operation in isolated pools that may harbor stranded fish. Fish will be removed from isolated pools by seining or electroshocking. The electroshocking or seining teams will include at least one person with a four-year college degree in fisheries biology, or a related degree. The person must also have at least two years of professional experience in fisheries field surveys and the use of electroshocking equipment. Fish collection assumes a two- to four-person team per electroshocker or seine to facilitate safe and efficient collection and transport. Up to 2 electroshocking or seining teams may be used to facilitate efficient fish removal, particularly in reaches where the average width of the channel is greater than 20 feet or where an abundance of instream cover makes fish capture difficult. The electroshocking team will complete a minimum of three passes through each isolated pool. The number of electroshocking passes may exceed three if necessary to achieve removal of most fish. At the end of each pass, captured fish will be transferred into buckets with aerated water or into in-river holding tanks (*e.g.*, buckets with small holes or other appropriately sized containers). Water temperature in holding buckets will be monitored and river water will be added or replaced as needed to maintain fish in good condition.

Fish will be counted and recorded by species. All fish will be released in the stream channel upstream of the construction area unless it is determined these fish are downstream migrants that should be released downstream of the affected areas. The number of Chinook salmon and steelhead captured and the number of Chinook salmon and steelhead accidentally killed prior to release will be reported by email to NMFS within five working days. All dead Chinook salmon and steelhead will be frozen and retained for at least six months prior to disposal to allow NMFS to provide direction for disposition.

5. Develop an Implementation Plan

As part of the environmental protection strategy, Reclamation will develop a mitigation, compensation, restoration, and reporting plan, referred to in this document as an Implementation Plan. The Implementation Plan will be developed through coordination with the State and Federal agencies responsible for the Restoration project. This plan will provide detailed information on how each mitigation measure will be implemented and monitored during the pre-construction,

construction, and post-construction periods. The Implementation Plan will contain the following documents to be followed during the construction phase:

- storm water pollution prevention plan including specific erosion control and site reclamation measures,
- spill prevention and countermeasure plan,
- habitat compensation plan,
- wetland and riparian mitigation and monitoring plan,
- Migratory Bird Treaty Act,
- environmental compliance monitoring program.

General information describing those plans which are related to the protection of aquatic ecosystems is provided in the following sections.

a. *Storm Water Pollution Prevention Plan (SWPPP)*

Reclamation and/or the construction contractor will prepare and implement a SWPPP as part of the National Pollutant Discharge Elimination System. The SWPPP will describe the following elements of the plan:

- best management practices (BMPs) (*e.g.*, sediment containment devices, protection of construction spoils, proper installation of cofferdams);
- site restoration;
- post-construction monitoring of the effectiveness of BMPs;
- contingency measures;
- details about contractor responsibilities;
- a list of responsible parties; and
- a list of agency contacts.

Measures in the plan will include, at a minimum:

- avoiding work or equipment operation in flowing water during in-channel activities by constructing cofferdams and diverting all flows around construction sites;

- conducting all construction work according to site-specific construction plans that minimize the potential for sediment input to the aquatic system, including constructing silt barriers immediately downstream of the construction site and minimizing disruption of the streambed at and adjacent to the construction site;

- using sedimentation fences, hay bales certified as weed-free, sandbags, water bars, and baffles as additional sources of protection for waters, ditches, and wetlands;

- identifying all areas requiring clearing, grading, revegetation, and recontouring and minimizing the areas to be cleared, graded, and recontoured;

- storing construction spoils out of the stream (above the ordinary high-water mark) and protecting receiving waters from these erosion source areas with sedimentation fences or other effective sediment control devices;

- grading spoil sites to minimize surface erosion; and

- covering bare areas with mulch and revegetating all cleared areas with appropriate native, non-invasive species.

These measures will be incorporated into the project design as conditions of this biological opinion and a CDFG section 1600 streambed alteration agreement. Specific requirements for reducing impacts on stream habitat will be coordinated with NMFS and CDFG during the agreement process. An application for a waste discharge permit will be filed. Compliance with the monitoring and reporting requirements for project construction is also necessary.

b. *Spill Prevention and Countermeasure Plan (SPCP)*

Before construction begins, Reclamation and/or the construction contractor will prepare a SPCP that includes strict on-site handling rules to keep construction and maintenance materials out of drainages and waterways. Goals of this plan will be to:

- prevent contamination of streamside soil and the watercourse from cement, concrete or concrete washing, asphalt, paint or other coating materials, oil or other petroleum products, and hazardous materials;

- clean up spills immediately and notify NMFS immediately of any spill and cleanup procedures;

- prepare, prior to construction, a spill control and response plan and restrict the volume of petroleum products allowed on-site to the volume that can be addressed by the control and spill response measures included in the plan;

- provide staging and storage areas outside the stream zone for equipment, construction materials, fuels, lubricants, solvents, and other possible contaminants;

- store hazardous substances in staging areas at least 100 feet from stream and other water surfaces;
- perform refueling and vehicle maintenance at least 100 feet from receiving waters;
- minimize equipment operations in flowing water and remove vehicles from the normal high-water area before refueling and lubrication; and
- inspect equipment to ensure that seals prevent any fuel, engine oil, and other fluids from leaking.

These measures will be incorporated into the project design as conditions of this biological opinion and a CDFG section 1600 streambed alteration agreement. Specific requirements for reducing impacts on stream habitat will be coordinated with NMFS and CDFG during the agreement process.

c. *Wetland and Riparian Mitigation and Monitoring Plan*

Reclamation, in consultation with NMFS, FWS, and CDFG, is preparing a wetland and riparian mitigation and monitoring plan to mitigate impacts on wetlands subject to U.S. Army Corps of Engineers (Corps) jurisdiction in the Restoration project area. The plan is intended to provide the Corps with sufficient information to determine the adequacy of the proposed mitigation and to issue a section 404 permit. The Corps will approve the plan prior to project construction activities that affect the Corps-jurisdictional areas in the project area.

The plan will be prepared to meet or exceed the specifications and mitigation requirements pertaining to Corps-jurisdictional areas specified in the Draft Fish and Wildlife Coordination Act report prepared for the Restoration project (FWS 2003a). The plan will also be provided to the SWRCB to determine the adequacy of the proposed mitigation with respect to water quality and to issue a Section 401 water quality certification for the project.

The goal of the mitigation effort is to avoid and minimize adverse effects on wetland and riparian habitat, as well as replace the acreage, function, and values of wetlands and riparian habitat permanently affected by the project. To support this goal, the wetland and riparian mitigation and monitoring plan will meet the following objectives:

- provide compensatory mitigation for permanent impacts in the form of habitat creation, restoration, preservation, or enhancement of wetland habitats in the Restoration project area (*i.e.*, Battle Creek Watershed);
- to the extent practicable, provide in-kind mitigation and design the habitats so that they will have equal or better function, value, and quality than the wetlands that will be affected by the project;
- immediately restore habitats that have been temporarily affected by Restoration project construction to predisturbance conditions;

- integrate concerns for special-status species (*e.g.*, valley elderberry longhorn beetle) into the mitigation design to the maximum degree practicable; and

- design the mitigation wetlands so that, once established, they will require no maintenance.

A performance monitoring report will be submitted by Reclamation to the Corps at the end of each monitoring year. The report will summarize monitoring methods, results, progress toward meeting the final performance standards, and corrective actions taken.

d. *Environmental Compliance Monitoring Program*

Reclamation will develop an environmental compliance construction monitoring program to ensure that the mitigation and compensation measures identified in the Battle Creek Environmental Impact Statement/Environmental Impact Report are implemented in an appropriate and timely manner. As part of this construction monitoring program, Reclamation will retain qualified biologists, environmental resource specialists, and archeologists to monitor construction activities near environmentally sensitive areas, including areas that support threatened, endangered, and special-status species; migratory bird nesting; woody riparian vegetation; wetlands and perennial drainage crossings; and cultural sites.

Construction monitors will be hired and trained by Reclamation prior to construction and will be responsible for daily pre-construction surveys, staking resources, on-site monitoring, clearing equipment and vehicle staging areas, documentation of violations and compliance, coordination with construction inspectors, and post-construction documentation. Resource monitors will be responsible for patrolling work zones and working with construction inspectors to ensure that barrier fencing, stakes, and required setback buffers are maintained.

The roles and responsibilities of the resource monitors and other individuals on the project, compliance documentation, and other elements of the environmental compliance monitoring program will be clearly outlined in the Implementation Plan.

D. Description of the Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area, for the purpose of this biological opinion, includes that portion of Battle Creek and all of its tributaries between the first natural fish passage barriers on the North and South Forks of Battle Creek, and the confluence of Battle Creek with the Sacramento River. The first natural impassible barrier on the North Fork is an unnamed feature approximately 14 miles upstream from the confluence of the North and South forks. The first natural impassible barrier on the South Fork is known as Angle Falls, and is located approximately six miles upstream from the South Diversion Dam.

III. STATUS OF THE SPECIES AND PROPOSED CRITICAL HABITAT

The following listed endangered and threatened species occur in the action area and may be affected by the Restoration project. In addition, the action area has been proposed as critical habitat for two of these species:

- Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) - endangered
- Central Valley spring-run Chinook salmon - threatened
- Central Valley steelhead - threatened
- Central Valley spring-run Chinook salmon critical habitat - proposed
- Central Valley steelhead critical habitat - proposed

A. Species and Critical Habitat Listing Status

Sacramento River winter-run Chinook salmon were originally listed as threatened in August 1989, under emergency provisions of the ESA, and formally listed as threatened in November 1990 (55 FR 46515). The Evolutionarily Significant Unit (ESU) consists of only one population that is confined to the upper Sacramento River in California's Central Valley. NMFS designated critical habitat for winter-run Chinook salmon on June 16, 1993 (58 FR 33212). They were reclassified as endangered on January 4, 1994 (59 FR 440), due to increased variability of run sizes, expected weak returns as a result of two small year classes in 1991 and 1993, and a 99 percent decline between 1966 and 1991. Critical habitat area was delineated as the Sacramento River from Keswick Dam, [river mile(RM) 302] to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (Delta), including Kimball Island, Winter Island, and Brown's Island; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge, and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge. The critical habitat designation identifies those physical and biological features of the habitat that are essential to the conservation of the species and that may require special management consideration and protection. Within the Sacramento River this includes the river water, river bottom (including those areas and associated gravel used by winter-run Chinook salmon as spawning substrate), and adjacent riparian zone used by fry and juveniles for rearing. In the areas west of Chipps Island, including San Francisco Bay to the Golden Gate Bridge, this designation includes the estuarine water column and essential foraging habitat and food resources utilized by winter-run Chinook salmon as part of their juvenile outmigration or adult spawning migrations.

Central Valley spring-run Chinook salmon were listed as threatened on September 16, 1999 (50 FR 50394). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River basin. On December 10, 2004, NMFS proposed the designation of critical habitat for Central Valley spring-run Chinook salmon. Although the December 10, 2004, proposal does not give a detailed written description of the exact boundaries of the stream reaches that are proposed to be designated as critical habitat, maps that were included in the proposal indicate that the majority of the action area (Battle Creek below natural the barriers) is proposed for designation as critical habitat for Central Valley spring-run Chinook salmon.

Central Valley steelhead were listed as threatened under the ESA on March 19, 1998 (63 FR 13347). This ESU consists of steelhead populations in the Sacramento and San Joaquin River (inclusive of and downstream of the Merced River) basins in California's Central Valley. On December 10, 2004, NMFS proposed the designation of critical habitat for Central Valley steelhead. Although the December 10, 2004, proposal does not give a detailed written description of the exact boundaries of the stream reaches that are proposed to be designated as critical habitat, maps that were included in the proposal indicate that the entire action area (Battle Creek and its tributaries below natural barriers) is proposed for designation as critical habitat for Central Valley steelhead.

1. Proposed and Final Listing Status Changes

On June 14, 2004, NMFS proposed to upgrade Sacramento River winter-run Chinook salmon from endangered to threatened status (69 FR 33102). However, on June 16, 2005, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of Sacramento River winter-run Chinook salmon as endangered (information on NMFS June 16, 2005, decision can be found at the following website: http://www.nwr.noaa.gov/AlseaResponse/20040528/index.html. It is anticipated that this decision will be published in the Federal Register around June 22, 2005). This decision was based on the continued threats to Sacramento River winter-run Chinook salmon and the continued likelihood of this ESU becoming extinct throughout all or a significant portion of its range.

In addition, on June 14, 2004, NMFS proposed several changes involving West Coast salmon hatchery populations. The following final decisions regarding Central Valley ESUs were issued on June 16, 2005: (1) The Livingston Stone National Fish Hatchery population has been included in the listed Sacramento River winter-run Chinook salmon population; (2) The Feather River Hatchery (FRH) spring-run Chinook salmon population has been included as part of the Central Valley spring-run Chinook salmon ESU.

Finally, the June 14, 2004, NMFS proposal included the following proposed changes involving Central Valley steelhead populations. (1) The Coleman National Fish Hatchery (CNFH) and FRH steelhead populations were proposed for inclusion in the listed population of steelhead (these populations were previously included in the ESU but were not deemed essential for conservation and thus not part of the listed steelhead population); and (2) all resident *O. mykiss*, present below natural or long-standing artificial barriers, were proposed to be included as part of the listed steelhead ESUs. The final decisions on these steelhead proposals has been deferred for six months for further scientific review.

B. Species Life History and Population Dynamics

1. Chinook Salmon

a. *General Life History*

Chinook salmon exhibit two generalized freshwater life-history types (Healey 1991). "Stream-type" Chinook salmon enter freshwater months before spawning and reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or parr within their first year. Spring-run Chinook salmon exhibit a stream-type life history. Adults enter freshwater in the spring, hold over summer, spawn in fall, and the juveniles typically spend a year or more in freshwater before emigrating. Winter-run Chinook salmon are somewhat anomalous in that they have characteristics of both stream- and ocean-type races (Healey 1991). Adults enter freshwater in winter or early spring, and delay spawning until spring or early summer (stream-type). However, juvenile winter-run Chinook salmon migrate to sea after only four to seven months of river life (ocean-type). Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over summering by adults and/or juveniles.

Chinook salmon mature between two and six years of age (Myers *et al.* 1998). Freshwater entry and spawning timing generally are thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and the actual time of spawning (Myers *et al.* 1998). Both spring-run and winter-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

During their upstream migration, adult Chinook salmon require streamflows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate streamflows also are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 °F to 56 °F (Bell 1991; CDFG 1998). Adult winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985) and migrate past Red Bluff Diversion Dam (RBDD) from mid-December through early August (NMFS 1997). The majority of the run passes RBDD from January through May, and peaks in mid-March (Hallock and Fisher 1985). The timing of migration may vary somewhat due to changes in river flows, dam operations, and water year type. Adult spring-run Chinook salmon enter the Delta from the Pacific Ocean beginning in January and enter natal streams from March to July (Myers *et al.* 1998). In Mill Creek, Van Woert (1964) noted that of 18,290 spring-run Chinook salmon observed from 1953 to 1963, 93.5 percent were counted between April 1 and July 14, and 89.3 percent were counted between April 29 and June 30. Typically, spring-run Chinook salmon utilize mid- to high elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, suitable water temperatures, depths, and velocities for redd construction, and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (FWS 1995). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad. Bell (1991) identifies the preferred water temperature for adult spring-run Chinook salmon migration as 38 °F to 56 °F. Boles (1988), recommends water temperatures below 65 °F for adult Chinook salmon migration, and Lindley *et al.* (2004) report that adult migration is blocked when temperatures reach 70 °F, and fish can become stressed as temperatures approach 70 °F. Reclamation reports that spring-run Chinook salmon holding over the summer prefer water temperatures below 60 °F, although salmon can tolerate temperatures up to 65 °F before they experience an increased susceptibility to disease. The upper preferred water temperature for spawning Chinook salmon is 55 °F to 57 °F (Chambers 1956; Reiser and Bjornn 1979). Winter-run Chinook salmon spawning occurs primarily from mid-April to mid-August, with the peak activity occurring in May and June in the Sacramento River reach between Keswick dam and RBDD (Vogel and Marine 1991). The majority of winter-run Chinook salmon spawners are three years old. Physical Habitat Simulation Model (PHABSIM) results (FWS 2003b) indicate winter-run Chinook salmon suitable spawning velocities in the upper Sacramento River are between 1.54 feet per second (ft/s) and 4.10 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter. Initial habitat suitability curves (HSCs) show spawning suitability rapidly decreases for water depths greater than 3.13 feet (FWS 2003b). Spring-run Chinook salmon spawning occurs between September and October, depending on water temperatures. Between 56 and 87 percent of adult spring-run Chinook salmon that enter the Sacramento River basin to spawn are 3 years old (Calkins *et al.* 1940; Fisher 1994). PHABSIM results indicate spring-run Chinook salmon suitable spawning velocities in Butte Creek are between 0.8 ft/s and 3.22 ft/s, and suitable spawning substrates are between 1 and 5 inches in diameter (FWS 2004). The initial HSC showed suitability rapidly decreasing for depths greater than one foot, but this effect was most likely due to the low availability of deeper water in Butte Creek with suitable velocities and substrates rather than a selection by spring-run Chinook salmon of only shallow depths for spawning (FWS 2004).

The optimal water temperature for egg incubation is 44 °F to 54 °F (Rich 1997). Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel percolation, and poor water quality. Studies of Chinook salmon egg survival to hatching conducted by Shelton (1995) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. The length of time required for eggs to develop and hatch is dependent on water temperature and is quite variable. Alderdice and Velsen (1978) found that the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 61 °F and 37 °F, respectively, when the incubation temperature was constant.

Winter-run Chinook salmon fry begin to emerge from the gravel in late June to early July and continue emerging through October (Fisher 1994), generally at night. Spring-run Chinook salmon fry emerge from the gravel from November to March and spend about 3 to 15 months in freshwater habitats prior to emigrating to the ocean (Kjelson *et al.* 1981). Post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on small insects and crustaceans.

When juvenile Chinook salmon reach a length of 50 to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Stream flow and/or turbidity increases in the upper Sacramento River basin are thought to stimulate emigration. Emigration of juvenile winter-run Chinook salmon past RBDD may begin as early as mid-July, typically peaks in September, and can continue through March in dry years (Vogel and Marine 1991; NMFS 1997). From 1995 to 1999, all winter-run Chinook salmon outmigrating as fry passed RBDD by October, and all outmigrating pre-smolts and smolts passed RBDD by March (Martin *et al.* 2001). Spring-run Chinook salmon emigration is highly variable (CDFG 1998). Some may begin outmigrating soon after emergence, whereas others over summer and emigrate as yearlings with the onset of intense fall storms (CDFG 1998). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of young-of-the-year outmigrants passing through the lower Sacramento River and Delta during this period (CDFG 1998).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, Delta, and their tributaries. Spring-run Chinook salmon juveniles have been observed rearing in the lower part of non-natal tributaries and intermittent streams during the winter months (Maslin *et al.* 1997; Snider 2001). Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (McDonald 1960; Dunford 1975). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson *et al.* 1982; Sommer *et al.* 2001; MacFarlane and Norton 2002).

Winter-run Chinook salmon fry remain in the San Francisco Bay estuary until they reach a fork length of about 118 mm (*i.e.*, 5 to 10 months of age) and then begin emigrating to the ocean as early as November and continue through May (Fisher 1994; Myers *et al.* 1998). Little is known about estuarine residence time of spring-run Chinook salmon. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (McFarlane and Norton 2002). Based on the mainly ocean-type life history observed (*i.e.*, fall-run Chinook salmon) MacFarlane and Norton (2002) concluded that unlike populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry. Spring-run Chinook yearlings are larger in size than fall-run Chinook and ready to smolt upon entering the Delta; therefore, they probably spend little time rearing in the Delta.

b. *Population Trend – Sacramento River Winter-run Chinook Salmon*

The distribution of winter-run Chinook salmon spawning and rearing historically was limited to the upper Sacramento River and tributaries, where spring-fed streams allowed for spawning, egg incubation, and rearing in cold water (Slater 1963; Yoshiyama *et al.* 1998). The headwaters of the McCloud, Pit, and Little Sacramento Rivers, and Hat and Battle Creeks, provided clean, loose gravel, cold, well-oxygenated water, and optimal flow in riffle habitats for spawning and incubation. These areas also provided the cold, productive waters necessary for egg and fry survival, and juvenile rearing over summer. Construction of Shasta Dam in 1943 and Keswick Dam in 1950 blocked access to all of these waters except Battle Creek, which is blocked by a weir at the CNFH and other small hydroelectric facilities (Moyle et al. 1989; NMFS 1997). Approximately, 299 miles of tributary spawning habitat in the upper Sacramento River is now blocked. Yoshiyama *et al.* (1998) estimated that the Upper Sacramento River in 1938 had a "potential spawning capacity" of 14,303 redds. Most components of the winter-run Chinook salmon life history (*e.g.*, spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River.

Following the construction of Shasta Dam, the number of winter-run Chinook salmon initially declined but recovered during the 1960s. The initial recovery was followed by a steady decline, subsequent to the construction of RBDD, from 1969 through the late 1980s (FWS 1991). Since 1967, the estimated adult winter-run Chinook salmon population ranged from 117,808 in 1969, to 186 in 1994 (NMFS 1997). The population declined from an average of 86,000 adults in 1967 to 1969 to only 1,900 in 1987 to 1989, and continued to remain low, with an average of approximately 2,500 fish for the period from 1998 to 2000 (Table 3). Between the time Shasta Dam was built and the listing of winter-run Chinook salmon as endangered, major impacts to the population occurred from warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, acid mine drainage from Iron Mountain Mine, and entrainment at a large number of unscreened or poorly-screened water diversions (NMFS 1997).

Population estimates from 2001 through 2004 show a consistent increase of at least 4,000 more adults compared to the previous 15 years (Table 3). The 2003 run (8,218 fish) was the highest since the listing. Also, there is an increasing trend in the five year moving average (491 from 1990-1994 to 5,451 from 1999-2003); and the five year moving average of cohort replacement rates has increased and appears to have stabilized over the same period.

c. *Status - Sacramento River Winter-run Chinook Salmon and Designated Critical Habitat*

Numerous factors have contributed to the decline of winter-run Chinook salmon through degradation of spawning, rearing and migration habitats. The primary impacts include blockage of historical habitat by Shasta and Keswick Dams, warm water releases from Shasta Dam, juvenile and adult passage constraints at RBDD, water exports in the southern Delta, heavy metal contamination from Iron Mountain Mine, high ocean harvest rates, and entrainment in a large number of unscreened or poorly screened water diversions. Secondary factors include smaller water manipulation facilities and dams, loss of rearing habitat in the lower Sacramento River and

Delta from levee construction, marshland reclamation, and interaction with and predation by introduced species (NMFS 1997).

Table 3. Winter-run Chinook salmon population estimates from Red Bluff Diversion Dam counts, and corresponding cohort replacement rates for the years since 1986 (CDFG 2004a).

Year	Population Estimate (RBDD)	5 Year Moving Average Population Estimate	Cohort Replacement Rate	5 Year Moving Average of Cohort Replacement Rate
1986	2596	-	-	-
1987	2186	-	-	-
1988	2885	-	-	-
1989	696	-	0.27	-
1990	430	1759	0.20	-
1991	211	1282	0.07	-
1992	1240	1092	1.78	-
1993	387	593	0.90	0.64
1994	186	491	0.88	0.77
1995	1297	664	1.05	0.94
1996	1337	889	3.45	1.61
1997	880	817	4.73	2.20
1998	3002	1340	2.31	2.49
1999	3288	1961	2.46	2.80
2000	1352	1972	1.54	2.90
2001	8224	3349	2.74	2.76
2002	7441	4661	2.26	2.26
2003	8218	5705	6.08	3.02
2004	7701	6587	0.94	2.71

Since the listing of winter-run Chinook salmon, several habitat problems that led to the decline of the species have been addressed and improved through restoration and conservation actions. The impetus for initiating restoration actions stem primarily from the following: (1) ESA section 7 consultation reasonable and prudent alternatives on temperature, flow, and operations of the Central Valley Project (CVP) and State Water Project; (2) SWRCB decisions requiring compliance with Sacramento River water temperature objectives which resulted in the installation of the Shasta Temperature Control Device in 1998; (3) a 1992 amendment to the authority of the CVP through the Central Valley Project Improvement Act (CVPIA) to give fish and wildlife equal priority with other CVP objectives; (4) fiscal support of habitat improvement projects from the CALFED Bay-Delta Program (*e.g.*, installation of a fish screen on the Glenn-Colusa Irrigation District diversion); (5) establishment of the CALFED Environmental Water Account (EWA); (6) Environmental Protection Agency (EPA) actions to control acid mine runoff from Iron Mountain Mine; and (7) ocean harvest restrictions implemented in 1995.

The susceptibility of winter-run Chinook salmon to extinction remains linked to the elimination of access to most of their historical spawning grounds and the reduction of their population structure to a small population size. Recent trends in winter-run Chinook salmon abundance and cohort replacement are positive and may indicate some recovery since thelisting. However, the population remains below the draft recovery goals established for the run (NMFS 1997). In general, the recovery criteria for winter-run Chinook salmon includes a mean annual spawning abundance over any 13 consecutive years to be 10,000 females and the geometric mean of the cohort replacement rate over those same years to be greater than 1.0.

d. *Population Trend – Central Valley Spring-run Chinook Salmon*

Historically, spring-run Chinook salmon were predominant throughout the Central Valley occupying the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit Rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874; Rutter 1904; Clark 1929). The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and the 1940s (CDFG 1998). Before construction of Friant Dam, nearly 50,000 adults were counted in the San Joaquin River alone (Fry 1961). Following the completion of Friant Dam, the native population from the San Joaquin River and its tributaries (*i.e.*, the Stanislaus and Mokelumne Rivers) was extirpated. Spring-run Chinook salmon no longer exist in the American River due to the operation of Folsom Dam. Naturally-spawning populations of Central Valley spring-run Chinook salmon are currently restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998).

On the Feather River, significant numbers of spring-run Chinook salmon, as identified by run timing, return to FRH. In 2002, FRH reported 4,189 returning spring-run Chinook salmon, which is 22 percent below the 10-year average of 4,727 fish. However, coded-wire tag (CWT) information from these hatchery returns indicates substantial introgression has occurred between fall-run and spring-run Chinook salmon populations in the Feather River due to hatchery practices. Because Chinook salmon are not temporally separated in the hatchery, spring-run Chinook and fall-run Chinook are spawned together, thus compromising the genetic integrity of the spring-run Chinook salmon. The number of naturally spawning spring-run Chinook salmon in the Feather River has been estimated only periodically since the 1960s, with estimates ranging from two fish in 1978 to 2,908 in 1964. The genetic integrity of this population is at question because there is significant temporal and spatial overlap between spawning populations of spring-run and fall-run Chinook salmon (NMFS 2003). For the reasons discussed previously, Feather River spring-run Chinook population numbers are not included in the following discussion of ESU abundance.

Since 1969, the Central Valley spring-run Chinook salmon ESU (excluding Feather River fish) has displayed broad fluctuations in abundance ranging from 25,890 in 1982 to 1,403 in 1993 (CDFG unpublished data). Even though the abundance of fish may increase from one year to the next, the overall average population trend has a negative slope during this time period. The average abundance for the ESU was 12,499 for the period of 1969 to 1979, 12,981 for the period of 1980 to 1990, and 6,542 for the period of 1991 to 2001. In 2003 and 2004, total run size for the ESU was 8,775 and 9,872 adults respectively, well above the 1991-2001 average.

Evaluating the ESU as a whole, however, masks significant changes that are occurring among metapopulations. For example, while the mainstem Sacramento River population has undergone a significant decline, the tributary populations have demonstrated a substantial increase. Average abundance of Sacramento River mainstem spring-run Chinook salmon recently has declined from a high of 12,107 for the period 1980 to 1990, to a low of 609 for the period 1991 to 2001, while the average abundance of Sacramento River tributary populations increased from a low of 1,227 to a high of 5,925 over the same periods. Although tributaries such as Mill and Deer Creeks have shown positive escapement trends since 1991, recent escapements to Butte Creek, including 20,259 in 1998, 9,605 in 2001, and 8,785 in 2002 are responsible for the overall increase in tributary abundance (CDFG 2002; CDFG, unpublished data). The Butte Creek estimates, which account for the majority of this ESU, do not include prespawning mortality. In the last several years as the Butte Creek population has increased, mortality of adult spawners has increased from 21 percent in 2002 to 60 percent in 2003 due to over-crowding and disease associated with high water temperatures. This trend may indicate that the population in Butte Creek may have reached its carrying capacity (Ward *et al.* 2003) or are near historical population levels.

The extent of spring-run Chinook salmon spawning in the mainstem of the upper Sacramento River is unclear. During aerial redd counts very few spring-run Chinook salmon redds (less than 15 per year) were observed from 1989 to 1993, and none in 1994 (FWS 2003b). Recently, the number of redds in September has varied from 29 to 105 during 2001 though 2003 depending on the number of survey flights (CDFG, unpublished data). In 2002, based on RBDD ladder counts, 485 spring-run Chinook adults may have spawned in the mainstem Sacramento River or entered upstream tributaries such as Clear or Battle Creek (CDFG 2004b). In 2003, no adult spring-run Chinook salmon were estimated to have spawned in the mainstem river. Due to geographic overlap of ESUs since the construction of Shasta Dam, Chinook salmon that spawn in the mainstem Sacramento River during September are more likely to be identified as early fall-run rather than spring-run Chinook salmon.

e. *Status of Spring-run Chinook Salmon and Proposed Critical Habitat*

The initial factors that led to the decline of spring-run Chinook salmon were related to the loss of upstream habitat behind impassable dams. Since this initial loss of habitat, other factors have contributed to the instability of the spring-run Chinook salmon population and affected the ESU's ability to recover. These factors include a combination of physical, biological, and management factors such as climatic variation, water management activities, hybridization with fall-run Chinook salmon, predation, and harvest (CDFG 1998). Since spring-run Chinook salmon adults must hold over for months in small tributaries before spawning they are much more susceptible to the effects of high water temperatures.

During the drought from 1986 to 1992, Central Valley spring-run Chinook salmon populations declined substantially. Reduced flows resulted in warm water temperatures and impacted adults, eggs, and juveniles. For adult spring-run Chinook salmon, reduced instream flows delayed or completely blocked access to holding and spawning habitats. Water management operations, (including reservoir releases, and unscreened or poorly-screened diversions in the Sacramento

River, Delta, and tributaries, compounded drought-related problems by further reducing river flows, warming river temperatures, and entraining juveniles.

Several actions have been taken to improve habitat conditions for spring-run Chinook salmon, including improved management of Central Valley water (*e.g.*, through use of CALFED EWA and CVPIA (b)(2) water accounts), implementing new and improved screen and ladder designs at major water diversions along the mainstem Sacramento River and tributaries, removal of several small dams on important spring-run Chinook salmon spawning streams, and changes in ocean and inland fishing regulations to minimize harvest. Although protective measures and habitat restoration likely have contributed to recent increases in spring-run Chinook salmon abundance, the ESU is still below levels observed from the 1960s through 1990. Threats from hatchery production (*i.e.*, competition for food between naturally-spawned and hatchery fish, and run hybridization and homogenization), climatic variation, reduced stream flows, high water temperatures, predation, and large scale water diversions persist. Because the Central Valley spring-run Chinook salmon ESU is confined to relatively few remaining streams and continues to display broad fluctuations in abundance, the population is at a moderate risk of extinction.

2. Steelhead

a. *General Life History*

Based on their state of sexual maturity at the time of river entry and the duration of their spawning migration, steelhead can be divided into two life history types: stream-maturing and ocean-maturing. Stream-maturing steelhead enter freshwater in a sexually immature condition and require several months to mature and spawn, whereas ocean-maturing steelhead enter freshwater with well-developed gonads and spawn shortly after river entry. These two life history types are more commonly referred to by their season of freshwater entry (*i.e.* summer [stream-maturing] and winter [ocean-maturing] steelhead). Only winter steelhead are currently found in Central Valley rivers and streams (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940s (Interagency Ecological Program [IEP] Steelhead Project Work Team 1999). At present, summer steelhead are found only in North Coast drainages, mostly in tributaries of the Eel, Klamath, and Trinity River systems (McEwan and Jackson 1996).

Winter steelhead generally leave the ocean from August through April, and spawn between December and May (Busby *et al.* 1996). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and the associated lower water temperatures. The preferred water temperature for adult steelhead migration is 46 °F to 52 °F (McEwan and Jackson 1996; Myrick 1998; Myrick and Cech 2000). Thermal stress may occur at temperatures beginning at 66 °F and mortality has been demonstrated at temperatures beginning at 70 °F. The preferred water temperature for steelhead spawning is 39 °F to 52 °F, and the preferred water temperature for steelhead egg incubation is 48 °F to 52 °F (McEwan and Jackson 1996; Myrick 1998; and Myrick and Cech 2000). The minimum stream depth necessary for successful upstream migration is 13 cm (Thompson 1972). Preferred water velocity for upstream migration is in the range of 40-90 cm/s, with a maximum velocity, beyond which upstream migration is not likely to occur, of 240 cm/s (Thompson 1972; Smith 1973).

Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996; Nickleson *et al.* 1992). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Most steelhead spawning takes place from late December through April, with peaks from January though March (Hallock *et al.* 1961). Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity, and may spawn in intermittent streams as well (Everest 1973; Barnhart 1986).

The length of the incubation period for steelhead eggs is dependent on water temperature, dissolved oxygen concentration, and substrate composition. In late spring and following yolk sac absorption, fry emerge from the gravel and actively begin feeding in shallow water along stream banks (Nickelson *et al.* 1992).

Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-the-year also are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refuge and as a means of avoiding predation (Shirvell 1990; Meehan and Bjornn 1991). Some older juveniles move downstream to rear in large tributaries and mainstem rivers (Nickelson *et al.* 1992). Juveniles feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and emerging fry are sometimes preyed upon by older juveniles.

Steelhead generally spend two years in freshwater before emigrating downstream (Hallock *et al.* 1961; Hallock 1989). Rearing steelhead juveniles prefer water temperatures of 45 °F to 58 °F and have an upper lethal limit of 75 °F. They can survive in water up to 81 °F with saturated dissolved oxygen conditions and a plentiful food supply. Reiser and Bjornn (1979) recommended that dissolved oxygen concentrations remain at or near saturation levels with temporary reductions no lower than 5.0 mg/l for successful rearing of juvenile steelhead. During rearing, suspended and deposited fine sediments can directly affect salmonids by abrading and clogging gills, and indirectly cause reduced feeding, avoidance reactions, destruction of food supplies, reduced egg and alevin survival, and changed rearing habitat (Reiser and Bjornn 1979). Bell (1973) found that silt loads of less than 25 mg/l permit good rearing conditions for juvenile salmonids.

Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows. Emigrating Central Valley steelhead use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean. Some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Barnhart (1986) reported that steelhead smolts in California range in size from 140 to 210 mm (fork length). Hallock *et al.* (1961) found that juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurred in the spring, with a much smaller peak in the fall.

b. *Population Trends – Central Valley Steelhead*

Steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996). Steelhead were found from the upper Sacramento and Pit River systems (now inaccessible due to Shasta and Keswick Dams), south to the Kings and possibly the Kern River systems (now inaccessible due to extensive alteration from water diversion projects), and in both east and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996). The California Advisory Committee on Salmon and Steelhead (1988) reported a reduction of steelhead habitat from 6,000 miles historically to 300 miles today. Historically, steelhead probably ascended Clear Creek past the French Gulch area, but access to the upper basin was blocked by Whiskeytown Dam in 1964 (Yoshiyama *et al.* 1996). Steelhead also occurred in the upper drainages of the Feather, American and Stanislaus Rivers which are now inaccessible (McEwan and Jackson 1996, Yoshiyama *et al.* 1996).

Historic Central Valley steelhead run size is difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s, the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally-spawned steelhead populations in the upper Sacramento River have declined substantially. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead in the Sacramento River, upstream of the Feather River, through the 1960s. Steelhead counts at the RBDD declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996, McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

Nobriga and Cadrett (2003) compared CWT and untagged (wild) steelhead smolt catch ratios at Chipps Island trawl from 1998 to 2001 and estimated that about 100,000 to 300,000 steelhead juveniles are produced naturally each year in the Central Valley. In the draft *Updated Status Review of West Coast Salmon and Steelhead* (NMFS 2003), the Biological Review Team (BRT) made the following conclusion based on the Chipps Island data:

> "If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s".

The only consistent data available on steelhead numbers in the San Joaquin River basin come from CDFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate a decline in steelhead numbers in the early 1990s, which have remained low through 2002 (CDFG 2003). In 2004, a total of 12 steelhead smolts were collected at Mossdale (CDFG, unpublished data).

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill Creeks and the Yuba River. Populations may exist in Big Chico and Butte Creeks and a few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996).

Recent snorkel surveys (1999 to 2002) indicate that steelhead are present in Clear Creek (J. Newton, FWS, pers. comm. 2002, as reported in NMFS 2003). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other streams previously thought to be void of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al.* 2000). It is possible that naturally spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999).

c. *Status of Central Valley Steelhead and Proposed Critical Habitat*

Both the BRT (NMFS 2003) and the Artificial Propagation Evaluation Workshop (69 FR 33102) concluded that the Central Valley steelhead ESU is "in danger of extinction." However, in the proposed status review NMFS concluded that the ESU in-total is "not in danger of extinction, but is likely to become endangered within the foreseeable future" citing unknown benefits of restoration efforts and a yet-to-be funded monitoring program (69 FR 33102). Steelhead have already been extirpated from most of their historical range in this region. Proposed critical habitat concerns in this ESU focus on the widespread degradation, destruction, and blockage of freshwater habitat within the region, and water allocation problems. Widespread hatchery steelhead production within this ESU also raises concerns about the potential ecological interactions between introduced stocks and native stocks. Because the Central Valley steelhead population has been fragmented into smaller isolated tributaries without any large source population and the remaining habitat continues to be degraded by water diversions and other land use practices, the population is at high risk of extinction.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species within the action area. The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR § 402.02).

The Battle Creek Watershed is in the Cascade Range foothill physiographic region (Hickman 1993). The Cascade region's geology is derived from the volcanic formations created by Mount Lassen and its predecessor volcanoes. The volcanic formations produce a type of hydrology that is unusual for the Central Valley, characterized by abundant cold water from spring flows and relatively high dry-season base flows.

Battle Creek is a tributary to the upper Sacramento River and is one of the only watersheds of significant size remaining in the Cascade region that is accessible to anadromous salmonids. It also has habitat types similar to those in which the now scarce runs of winter- and spring-run Chinook salmon evolved (FWS 1995a). Prior to the hydroelectric development in Battle Creek watershed more than a century ago, prime habitat for Chinook salmon and steelhead extended from the confluence with the Sacramento River upstream to natural barrier waterfalls on North Fork and South Fork Battle Creek.

Battle Creek is a high-gradient, headwater stream with an elevation change in excess of 5,000 ft over 50 miles. The creek flows through remote, deep, shaded canyons and riparian corridors with little development near its banks. The Battle Creek channel is characterized by alternating pools and riffles. Boulders, ledges, and turbulence provide diversity to the channel form. Substrate size ranges from sand to boulder with predominantly gravel and cobble throughout the system. Concentration and types of gravel deposits are directly correlated to stream gradient. Sediment mobility studies imply that gravel in Battle Creek moves with enough frequency to keep it clean of fine sediment and loose enough to support spawning by Chinook salmon and steelhead (Reclamation 2001).

A. Status of the Listed Species and Proposed Critical Habitat within the Action Area

1. Sacramento River Winter-Run Chinook Salmon

Winter-run Chinook salmon are indigenous to Battle Creek (Kier Associates 1999). However, no reliable records exist that document the size of the population prior to 1995. Historically, systematic counts of adult winter-run Chinook salmon had not been made because of unfavorable environmental conditions during the high-flow winter months when these fish migrate upstream.

The occurrence of successfully reproducing winter-run Chinook salmon in Battle Creek was first documented in 1898 and again in 1900, when the U.S. Fish Commission collected salmon fry in specially-designed nets (Rutter 1904). Small, newly-emerged salmon fry (of a size that could only have been winter-run Chinook salmon) were captured in Battle Creek in September and early October (Rutter 1904; FWS 1992).

A spawning run of adult winter-run Chinook salmon in Battle Creek was documented during the late 1940s and early 1950s, when the CNFH began late fall-run Chinook salmon egg-taking operations (FWS 1987). From the 1950s to the early 1960s, CDFG reported the existence of winter-run Chinook salmon in Battle Creek during a statewide inventory of steelhead and salmon resources, but provided no estimate of the size of the population in Battle Creek (CDFG 1965). The CNFH trapped winter-run Chinook salmon in Battle Creek during the late 1950s, including 309 winter-run Chinook salmon in 1958 (FWS 1963), suggesting that winter-run Chinook salmon populations in Battle Creek reached a level of at least 300 adults during this period. Documentation of 24 adult winter-run Chinook salmon in South Fork Battle Creek in 1965 (CDFG 1966) indicates that winter-run Chinook salmon populations persisted in Battle Creek during the mid-1960s. No records exist that document the size of winter-run Chinook salmon populations in Battle Creek from the mid-1960s to the mid-1990s.

Since 1995, as part of its brood stock collection efforts, FWS has counted winter-run Chinook salmon in Battle Creek at the CNFH during the September-through-February portion of the winter-run Chinook salmon migration period. Winter-run Chinook salmon are also counted from March through June at the CNFH barrier weir, using trapping and videography. Altogether, these monitoring techniques account for most of the December-to-August spawning and migration period of adult winter-run Chinook salmon. Additionally, snorkel surveys and juvenile outmigrant trapping have been conducted on Battle Creek during this time period.

Monitoring information derived from the methods described above, have indicated that hatchery-origin winter-run Chinook salmon from past artificial propagation efforts at the CNFH (FWS 1995a, 1996) have returned to Battle Creek. The catch of a small number of nonhatchery-origin winter-run Chinook salmon in 1998 (FWS 1998) and 2000 indicates that Battle Creek may still have supported a remnant population (fewer than 10 documented fish) of naturally produced winter-run Chinook salmon at that time.

Although extensive monitoring for both adult and juvenile winter-run Chinook salmon has been consistently conducted in Battle Creek since 2000, no evidence of adult spawning or natal juvenile rearing has been detected (FWS, unpublished data). Therefore, it is likely that there is no longer a viable, naturally-reproducing population of winter-run Chinook salmon in Battle Creek.

2. <u>Sacramento River Winter-Run Chinook Salmon Designated Critical Habitat</u>

Critical habitat for Sacramento River winter-run Chinook salmon was only designated within the Sacramento River and lower estuary areas, and not in any tributary streams. Therefore, there is no designated critical habitat within the action area.

3. <u>Central Valley Spring-Run Chinook Salmon</u>

Recent monitoring indicates that approximately 50 to 100 adult spring-run Chinook salmon have used Battle Creek for holding and spawning annually during the past several years, although these population estimates are not precise (FWS 2002). Current populations of spring-run Chinook salmon appear to be severely depressed when compared to populations that existed in the 1940s and 1950s.

At the beginning of CNFH operations, the hatchery collected 227, 1,181, 468, and 2,450 spring-run Chinook salmon from Battle Creek each year from 1943 to 1946, respectively, indicating that a relatively large population was present in the creek (FWS 1949). From 1952 to 1956, annual estimates of adult spring-run Chinook salmon in Battle Creek ranged from 1,700 to 2,200 (CDFG 1961).

Stream surveys in the early 1960s indicated that spring-run Chinook salmon utilized various areas of the Restoration project area including Eagle Canyon and South Fork Battle Creek upstream of Panther Creek, but these studies did not provide population estimates (CDFG 1966; Tehama County Community Development Group 1983). Spring-run Chinook salmon (*i.e.*, 40 to 50 adult fish) were again observed in Eagle Canyon in 1970, but no systematic population estimate was provided (CDFG 1970).

From 1995 to 1998, the FWS estimated the number of spring-run Chinook salmon located in holding habitat upstream of the CNFH barrier dam. These population estimates ranged from about 50 to 100 spring-run Chinook salmon (FWS 1996, 2000, 2002). From 1998 to 2001, the FWS counted Chinook salmon in Battle Creek during part of the spring-run Chinook salmon migration period. These partial counts indicate that perhaps as many as 71 to 100 spring-run Chinook salmon passed the CNFH barrier weir into the project area annually from 1998 to 2001.

4. <u>Central Valley Spring-Run Chinook Salmon Proposed Critical Habitat</u>

a. *Holding, Spawning, and Rearing Habitat*

The total estimated area of suitable spawning gravel in Battle Creek is 57,000 square feet in the mainstem above Coleman Powerhouse; 81,000 square feet in the North Fork up to the barrier waterfall; and 28,000 square feet in the South Fork up to Angel Falls (Payne and Associates 1994). Concentration and types of gravel deposits are directly correlated to stream gradient. Mobility studies imply that gravel in Battle Creek moves with enough frequency to keep it relatively free of fine sediment and loose enough to support spawning. The Battle Creek channel is characterized by alternating pools and riffles. The channel form, along with boulders, ledges, and turbulence, provides key elements of holding and rearing habitat for spring-run Chinook salmon.

b. *Migration Habitat*

Absolute natural barriers mark the terminus of anadromous salmonid habitat on North Fork and South Fork Battle Creek. In the steep, high-elevation stream reaches below these absolute barriers there are natural features in the channel, such as boulders and logs that can impede passage depending on vertical drop, flow depth, and flow velocity. Seven diversion dams block or impede passage of spring-run Chinook salmon and other fish species. A fish barrier at CNFH can also impede passage to varying degrees (depending on barrier weir operations) throughout the year.

c. Contaminants

Water samples were collected at eight sites in the Battle Creek Watershed and analyzed for metal, total suspended solids, and oil and grease (Reclamation 2004). The results revealed that each of these parameters was within the EPA's recommended levels for aquatic life. Contaminant levels in Battle Creek are relatively low and adverse effects are not documented.

5. <u>Central Valley Steelhead</u>

Operational records for CNFH provide information on the numbers of steelhead that have been passed upstream of the hatchery's barrier weir to spawn naturally in Battle Creek. Beginning in the early 1950s, an assumed mixture of hatchery and natural steelhead have been intermittently released above the barrier weir. Specifically, hatchery records from 1953 through 1995 document frequent releases of adults (from 100 to approximately 1,500 fish per year) above the CNFH barrier weir and it is likely that additional, undocumented releases also occurred (Campton *et al.* 2004). Releases of hatchery and natural steelhead adults above the CNFH barrier weir have also occurred annually since 1995 to take advantage of increased instream flows resulting from interim flow agreements associated with the Restoration project (Table 4).

Steelhead in Battle Creek are able to jump over the CNFH barrier weir when the upstream fish ladder is closed, especially during periods of high flow. Monitoring of Central Valley fall-run Chinook salmon at the hatchery's barrier weir has shown that escapement past the weir increases as flows exceed 350 cfs. Steelhead are generally considered to have superior leaping abilities compared to fall-run Chinook salmon and are therefore able to escape past the weir at lower flows and with greater frequency. During the principal period of steelhead migration in Battle Creek (October-February), average monthly flow ranges from 296 cfs in October to 727 cfs in February, suggesting that some escapement past the weir likely occurs throughout the timing of steelhead migration (Kier and Associates 1999). However, the number of uncounted steelhead escaping past the weir is unknown. When the fish ladders are open, it is believed that most steelhead use the ladders to travel upstream rather than attempting to jump over the barrier weir and are able to be counted (Campton *et al.* 2004).

6. <u>Central Valley Steelhead Proposed Critical Habitat</u>

The primary constituent elements of proposed critical habitat for steelhead within the action area are nearly identical to those for spring-run Chinook salmon. Therefore, the status of proposed critical habitat for steelhead can be considered the same as that provided above for spring-run Chinook salmon.

Table 4. Numbers of steelhead collected at CNFH and released above the barrier weir in Battle Creek, return years 1995/1996 - 2003/2004. Data shown in this table includes steelhead collected at the CNFH during broodstock collection operations and steelhead trapped or observed at the CNFH barrier weir after broodstock collection had ended (Campton *et al.* 2004).

	Steelhead Released above the CNFH Barrier Weir		
Return Year	Marked (Hatchery)	Unmarked (Natural)	Total
1995-1996			276[a]
1996-1997			295[a]
1997-1998			418[a]
1998-1999			1,163[a]
1999-2000			1,416[a]
2000-2001	1,352	131	1,483[b]
2001-2002	1,428	410	1,838
2002-2003	770	475	1,245
2003-2004	321	171	492[c]

a. A comprehensive marking program for juvenile steelhead produced at CNFH began in 1998, therefore, differentiation between natural and hatchery adults based on mark status was not entirely possible until the 2001-2002 return year.
b. During 1997 approximately 75 percent of the juvenile steelhead released from Coleman NFH were marked with an adipose fin clip resulting in age-3 hatchery adults being marked at a rate of 75 percent during 2000-2001.
c. 2003-2004 Data does not include steelhead collected after March 1, 2004.

B. Factors affecting species and proposed critical habitat within the action area

The baseline factors discussed below can be assumed to affect all three species unless specifically otherwise stated in the text.

1. <u>Hydroelectric Project Effects</u>

a. *Migration Impacts at Dams*

The North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Inskip, and South Diversion Dams block or impede passage into approximately 55 miles of upstream habitat. The fish ladders at Eagle Canyon, Wildcat, and Coleman Diversion Dams are considered ineffective under most flow conditions and are impossible to maintain during high flows (California Department of Water Resources 1997, 1998). During average or wet water years, fish ladders at North Battle Creek Feeder, Eagle Canyon, Wildcat, Inskip, and Coleman Diversion Dams are generally ineffective for 3 to 8 months because flow exceeds the maximum effective capacity of the ladders by a factor of 10 or more. Fish ladders at Eagle Canyon and Coleman Diversion

Dams were intentionally closed to fish passage under the 1998 Interim Flow Agreement (in anticipation of the Restoration project). This agreement provides sufficient flows below these dams to support salmonids, while blocking passage at the dams to prevent fish from entering the areas above the dams which have unstable flows and unscreened diversions.

Passage conditions that support migration of salmonids in Battle Creek also have been affected by the reduction in streamflow attributable to diversions for power production. Natural events, such as floods, can alter physical characteristics of the channel, including depth of pools from which the fish jump, height that must be jumped, water velocity, slope of the streambed, and the length of the slope, all factors affecting passage. An on-site survey identified transitory barriers in 18 locations on North Fork Battle Creek and 5 locations on South Fork Battle Creek (Payne and Associates 1998). Passage of all or some adult Chinook salmon could be impaired under streamflow conditions in the range controlled by the hydroelectric diversions. On North Fork Battle Creek, obstacles require greater amounts of streamflow for unimpaired passage than on South Fork Battle Creek. In one extreme case on North Fork Battle Creek (RM 5.14), an especially steep transitory barrier was modified by CDFG in 1997 to provide numerous ascent routes at more gradual slopes (Kier Associates 1999).

b. *Reduced Instream Flows*

One of the primary impacts of the hydroelectric project affecting salmonid spawning success and survival in Battle Creek is streamflow. Diversion of flows for power generation has substantially reduced streamflow in nearly all the reaches of Battle Creek downstream of Keswick Diversion Dam and South Diversion Dam. Minimum instream flow requirements under the current FERC license are 5 cfs in South Fork Battle Creek, and only 3 cfs in North Fork Battle Creek. Several of the tributaries to the creek (Soap, Ripley, and Baldwin Creeks) have minimum flow requirements of 0 cfs. These minimal streamflow requirements have greatly reduced holding, spawning and rearing habitat quality, and area available to salmonids, which has in turn caused a significant reduction in the population sizes and survival rates of these species.

c. *Increased Water Temperatures*

Habitat quality and salmonid survival in Battle Creek is significantly affected by water temperature as influenced by the hydro-project's diversion of cold spring water away from adjacent stream sections and reduced flows in the stream below diversion dams. Other factors that influence water temperature in Battle Creek include weather, channel form and dimension, shade, and natural flow levels. Flow diversion and subsequent warming substantially reduce the habitat area that can support migration, holding, spawning, and rearing of salmonids in Battle Creek (Kier Associates 1999).

Transbasin water diversions from North Fork Battle Creek to the South Fork tend to warm North Fork Battle Creek and cool South Fork Battle Creek. These operations have a detrimental effect on habitat conditions in the North Fork while potentially improving temperature conditions in the South Fork. However, the supply of cold water to the South Fork is not reliable. Canal and powerhouse outages occur at unpredictable times, producing substantial flow and temperature fluctuations that reduce habitat value for fish that are lured to the South Fork by the cold water releases from the hydropower system.

d. *Entrainment into Canals and Turbines*

Downstream migration of juvenile salmonids has also been impacted by the diversion of water at each dam (prior to the 1998 Interim Flow Agreement). Because up to 97 percent of the flow is diverted from Battle Creek for power production (Reclamation 2004) and fish screens are absent from all of these diversions, any juvenile fish spawned above the dams are likely to be entrained. Survival of passage through the power canals and turbines is thought to be minimal and most entrained fish are lost from the population. This reduction in juvenile survival is a key factor in the overall decline in salmonid populations in Battle Creek.

e. *Food*

Food availability and type affect fitness and survival of juvenile salmonids. Flow affects stream surface area and production of food. A primary factor affecting food production in Battle Creek is streamflow. Diversion for power generation has substantially reduced streamflow in all the reaches of Battle Creek downstream of Keswick Diversion Dam and South Diversion Dam. In addition, hydropower diversions entrain food organisms, exporting nutrients from segments of Battle Creek.

The density of adult salmon carcasses has been shown to increase nutrient input to stream systems and contribute to increased growth rates of juvenile salmonids (Wipfli *et al.* 2002). The historical reduction of Chinook salmon populations may have reduced food availability and productivity of Battle Creek.

2. <u>Agricultural Effects</u>

a. *Entrainment into Canals*

There are two significant agricultural diversions on lower Battle Creek, the Gover ditch and the Orwick ditch. Each diverts approximately 50 cfs from the creek. For many years, neither of these diversions had any sort of screening to prevent fish from being entrained into the ditches. Any juveniles that were entrained were most likely lost due to high water temperatures, predation, or desiccation in the fields. Within the last five years both diversions were fitted with fish screens. The screen on the Gover diversion meets most of the NMFS screening criteria and functions well in preventing entrainment of salmonids into the ditch during the irrigation season. However, during high flow periods, this screen is often overwhelmed by flows and debris. The screen panels are often removed during these periods allowing juvenile salmonids to be entrained into the ditch. The screen on the Orwick diversion does not meet many of the NMFS screening criteria. It is often overtopped by high flows and screen panels are often removed completely which allows entrainment of juvenile salmonids. The bypass system on the Orwick screen also is inadequate; instead of returning screened fish back to the main channel of Battle Creek, it empties into a side channel that is dry throughout much of the year. These impacts can cause increased stress and mortality of listed salmonids that are entrained into the diversion.

b. *Reduced Instream Flows*

These diversions can also divert a significant proportion of the total stream flow in Battle Creek during low water periods. This reduction in stream flow can lead to increased water temperatures and reduced food production and availability, resulting in reduced fitness and survival of juvenile and adult salmonids.

c. *Seasonal Dams*

Irrigators on both ditches have periodically pushed up large gravel dams to insure sufficient water is diverted into their ditches. These dams are built using heavy equipment within the stream bed to dig up the bed of the creek and pile it into large berms that back water up in front of the diversions and deflect the water into the ditches. This instream construction and disruption of the stream bed can cause direct injury and mortality of juvenile salmonids and incubating eggs. These activities also can cause increased mobilization of fine sediments which can negatively impact downstream salmonids and spawning beds (see Effects of the Action section).

3. <u>Hatchery Effects</u>

a. *Migration Impacts at Hatchery Weir*

CNFH operates a barrier weir along with a fish ladder 5.5 miles upstream of Battle Creek's confluence with the Sacramento River (FWS 2001). The upstream fish ladder is well designed and relatively effective in allowing unimpeded passage when it is opened. When the fish ladder is closed (August 1 through early March), the barrier weir either blocks passage or diverts fish into the hatchery. However, the barrier is not considered to be completely effective and some adult Chinook salmon and steelhead are able to jump over the barrier, especially at flows exceeding 350 cfs. The barrier weir is operated to provide broodstock for the hatchery and to manage and monitor passage of adult salmonids into upper Battle Creek. The current management objectives are to:

- divert adult fish into the hatchery facilities to provide broodstock for hatchery production;
- minimize the potential for hybridization between co-occurring runs of Chinook salmon in Battle Creek upstream of the barrier weir;
- minimize interactions between natural and hatchery runs of Chinook salmon and steelhead in Battle Creek upstream of the barrier weir;
- minimize the risk of infectious hematopoietic necrosis virus being shed into CNFH water supply upstream of the barrier weir; and
- monitor and study passing salmonids.

Because the upstream ladders on the barrier weir are closed from August 1 through early March, winter-run Chinook salmon and steelhead, which migrate upstream during this period, are likely to be impacted through migration delay, blockage, capture, handling, and unintentional mortality within the hatchery facilities (FWS 2000). Spring-run Chinook salmon migrate into Battle Creek from March through July and therefore are unlikely to be significantly impacted by the operation of the barrier weir.

b. *Entrainment Into Water Intakes*

Diversion of the water supply for CNFH out of Battle Creek results in the entrainment of juvenile salmonids into the hatchery intake system. The primary diversion point for CNFH (intake 1) is located in the tailrace of the Coleman Powerhouse. The water discharged from this powerhouse (and collected by intake 1) is diverted from the creek far upstream, above the natural passage barriers, and therefore is free of anadromous salmonids (FWS 2000). CNFH also uses two other water intakes on Battle Creek (intakes 2 and 3). These intakes entrain or impinge juvenile salmonids because they take water directly from lower Battle Creek and they have, until recently, been unscreened (intake 3 was recently fitted with a screen which does not meet all of NMFS' screening criteria, intake 2 remains completely unscreened). The estimated annual levels of impingement and/or entrainment of listed salmonids at these 2 intakes are 5,940 winter-run Chinook salmon, 814 spring-run Chinook salmon, and 6,269 steelhead (FWS 2000).

Periodic salvage operations conducted by FWS hatchery personnel have been moderately successful at rescuing entrained fish from the hatchery canal and sand filter. An example of one such operation took place from May 24 to July 13, 2000, during which 782 Chinook salmon and 749 steelhead were collected and released back into Battle Creek.

c. *Deleterious Genetic Effects*

Genetic integration of CNFH domestic stocks with wild Battle Creek salmonid populations has occurred over many years. During the winter-run propagation program at CNFH there was evidence of hatchery crossings of winter-run Chinook salmon with wild Battle Creek spring-run Chinook salmon (FWS 2000). The steelhead propagation program at CNFH also has had a long history of crossing hatchery origin fish with naturally-spawned Battle Creek fish and passing hatchery origin adults into upper Battle Creek to spawn with wild steelhead. Because of domestication effects in hatchery stocks (*i.e.*, a reduction in fitness of a stock due to prolonged hatchery propagation), the integration of these domestic stocks with wild populations, particularly wild populations whose numbers have been depressed through other factors, can reduce the overall fitness of the wild population and reduce its likelihood of recovering to self-sustaining levels (Chilcote 2003; Reisenbichler *et al.* 2003).

A recent decision by the agencies involved in management of steelhead and CNFH operations (FWS, NMFS, CDFG, and Reclamation) has ended the practice of deliberately passing hatchery origin steelhead above the CNFH barrier weir. The cessation of passing hatchery steelhead above the weir was implemented in order to allow the naturally-spawning population in upper Battle Creek to recover without excessive influence from hatchery stocks.

4. Predation

Predation by native and nonnative species may cause substantial mortality of salmonids and other species, especially where the stream channel or habitat conditions have been altered from natural conditions (California Department of Water Resources 1995). The existing diversion dams in the action area may create environmental conditions that increase the probability that predator species will capture juvenile Chinook salmon and steelhead during downstream movement. Water turbulence in the vicinity of the dams and other structures may disorient migrating juvenile Chinook salmon and steelhead, increasing their vulnerability to predators. In addition, changes in water temperature, flow velocity and depth affect the quality of habitat and potentially increase vulnerability of fish species to predation by other fish species, birds, and mammals.

C. Likelihood of Species Survival and Recovery in the Action Area

Under baseline conditions, without implementation of the Restoration project, the likelihood of survival and recovery of naturally-reproducing winter-run Chinook salmon, spring-run Chinook salmon, and steelhead in Battle Creek is very low. Winter-run Chinook salmon are thought to be completely extirpated from the creek, and continuation of the current hydropower operations is likely to continue to produce the poor habitat conditions in Battle Creek under which winter-run Chinook salmon have been unable to survive. Naturally-reproducing spring-run Chinook salmon and steelhead still maintain remnant populations in Battle Creek, but their numbers have shown a decreasing trend in recent decades. Without access to the upper reaches of the creek, screening of the hydropower diversions, and increased minimum flow requirements, it is unlikely that they will be able to maintain these remnant populations, and even less likely that they will actually recover to a point of long-term sustainability.

V. EFFECTS OF THE ACTION

A. Approach to the Assessment

To conduct this assessment, NMFS examined an extensive amount of evidence from a variety of sources. Detailed background information on the status of these species and the potential effects of this project on these species has been taken from a number of documents including project-specific environmental reports, peer reviewed scientific journals, primary reference materials, government and non-government reports, project meetings and personal communications.

B. Assessment

The dominant effect of the structural and operational changes proposed in this project will be to improve overall conditions for listed salmonids by removing migrational barriers, increasing minimum instream flows, and reducing entrainment into diversions.

There remains the potential for short-term, adverse impacts which will be expected to occur primarily during the construction phase of the project. The avoidance, minimization, and restoration measures that have been incorporated into the project design are expected to greatly reduce the severity of any such adverse impacts.

1. Construction Effects

a. *Increased Erosion and Sedimentation*

At all of the major construction sites associated with the Restoration project, vegetation will be removed and the soil will be graded in order to construct staging areas, new structures, and new roads and to expand existing roads. Construction and demolition activities adjacent to or in the stream channel of Battle Creek and its tributaries will disturb soils and the streambed, potentially leading to erosion and increased input of fine sediment into the streams.

Increased input of fine sediments can adversely affect listed salmonids. High turbidity caused by fine sediment transport into streams affects salmonids by reducing feeding success, causing avoidance of rearing habitats, and disrupting upstream and downstream migration. Displacement of juveniles from preferred habitats may cause increased susceptibility of juveniles to predation. Bisson and Bilby (1982) reported that juvenile coho salmon avoid turbidities exceeding 70 Nephelometric Turbidity Units (NTU), and Sigler *et al.* (1984) in Bjornn and Reiser (1991) found that turbidities between 25 and 50 NTUs reduced growth of juvenile coho salmon and steelhead. Turbidity should affect Chinook salmon in much the same way it affects juvenile steelhead and coho salmon because of similar physiological and life history requirements between the species. Increased sediment delivery and high levels of sediment transport also can cause infiltration of fine sediment into spawning gravels, decreased substrate permeability and intergravel flow and, ultimately, lead to reductions in the numbers of emergent salmonid fry (Lisle and Eads 1991). Increased sediment delivery can also fill interstitial substrate spaces and reduce abundance and availability of aquatic invertebrates for food (Bjornn and Reiser 1991).

Implementation of a SWPPP, including the use of sediment fences and other sedimentation reduction devices, prompt revegetation of disturbed soils, and prohibition of the use of construction equipment within flowing water, is expected to prevent construction activities from causing turbidity and sedimentation levels high enough to adversely affect salmonids as described above. The SWPPP, as a requirement of the National Pollutant Discharge Elimination System permit must ensure that all construction activities are conducted in a manner that attains the water quality objectives designated by the Central Valley Regional Water Quality Control Board for the maintenance of salmon and steelhead in occupied habitats.

b. *Release of Instream Sediments Behind Dams*

Removal of Wildcat, Coleman, and South Diversion Dams will release sediments trapped behind these dams to the stream channel. The volume and type of sediment stored behind the dams vary although composite samples taken behind each dam in 1999 found little organic material or fine sediment (Reclamation 2003). The two dams with substantial volumes of sediment trapped behind them are South Diversion Dam with 30,000 cubic yards and Coleman Diversion Dam with 28,000 cubic yards. Wildcat Diversion Dam is relatively small, and its removal will not release substantial sediment. Removal of diversion dams on Ripley and Soap Creeks also will release some sediment, but the dams are very small and do not retain substantial volumes of sediment behind them.

Adverse effects will be avoided or minimized at Coleman and South Diversion Dams through excavation of pilot channels in the sediments behind the dams. Each pilot channel will extend from the dam, upstream for approximately 200 feet to facilitate sediment flushing and to ensure that adequate fish passage is provided. The sediments that will be released from behind the five dams proposed for removal consist primarily of larger materials (>1/16 inch) not considered harmful to salmonids and potentially beneficial to spawning habitat. Any release of fine sediments is expected to be temporary in nature and is likely to occur during naturally high flushing flows when the fine sediments will be held in suspension and flushed completely out of the system, thereby minimizing effects on spawning habitat and incubating eggs. Naturally high turbidity levels occur during these flushing flows and the addition of sediment from behind the dams is not expected to significantly increase turbidity impacts during these flushing events. Therefore, the release of sediments from behind removed dams is expected to have minor, short-term effects on listed salmonids that are anticipated to be insignificant.

c. *Accidental Spill of Petroleum Products and Other Contaminants*

Water quality and fish habitat could be impacted from accidental spills or seepage of hazardous materials during construction. The implementation of the SPCP and other conservation measures discussed in section II, *Description of the Proposed Action*, are expected to prevent these adverse effects from occurring by implementing the best available preventative measures. Specific requirements of the SPCP include but are not limited to: Preparation of a spill control and response plan and the restriction of petroleum products allowed on site to the volume that can be addressed by the control and spill response measures included in the plan; establishment of staging and storage areas outside the stream zone for equipment, construction materials, fuels, lubricants, solvents, and other possible contaminants; and inspection of equipment to ensure that seals prevent any fuel, engine oil, and other fluids from leaking.

d. *Cofferdam Construction - Pile Driving*

Physical injury and death of eggs and larvae of listed salmonids can be caused by percussion-related shock waves generated by sheet pile driving activities associated with the construction of cofferdams at the sites where instream work will be required. Sheet pile driving can also invoke a startle and avoidance response in smaller juvenile salmonids (McKinley and Patrick 1986).

Coleman Diversion Dam, the downstream-most dam on South Fork Battle Creek, will remain in place and its fish ladder will be closed throughout all construction activities on the facilities upstream of this dam. Therefore, no anadromous species are expected to be impacted by any of the construction activities in the vicinity of the facilities upstream of Coleman Diversion Dam (*i.e.*, Inskip Powerhouse, Inskip Diversion Dam, South Powerhouse, South Diversion Dam, Lower Ripley Creek Diversion Dam, and Soap Creek Feeder Diversion Dam). The fish ladder at Eagle Canyon Dam on North Fork Battle Creek will likewise remain closed during construction activities at North Battle Creek Feeder Dam (upstream of Eagle Canyon) and will therefore prevent any anadromous species from being impacted by construction activities at North Battle Creek Feeder Diversion Dam.

The only active construction sites that will be accessible to anadromous salmonids are Coleman, Wildcat, and Eagle Canyon Diversion Dams. The area below Eagle Canyon Diversion Dam provides poor habitat for salmonids, consisting primarily of large jumbles of boulders with only small pools and chutes in between. Extensive biological monitoring over multiple years in this area has detected extremely low densities of anadromous salmonids. In fact, only one adult salmon and five juvenile steelhead have ever been observed in this area, though it has been surveyed on a monthly basis for several years (FWS unpublished data). No spawning activity has ever been detected at this site. The areas below Coleman and Wildcat Diversions Dams provide suitable habitat for salmonid holding, rearing, and spawning and frequent surveys have consistently detected both adult and juvenile salmonids in these areas.

Pile driving and instream excavation activities at the three accessible sites will occur only between May 1 and September 1 of each construction year (see Table 2 in project description), thereby avoiding any impacts to spawning Chinook salmon and incubating salmon eggs. The majority of steelhead spawning and incubation will also be avoided, although there is the possibility that a small proportion of steelhead larvae (those spawned in late March and April within 150 feet of sheet pile driving) could be injured or killed at the two sites that provide suitable spawning habitat (Wildcat and Coleman Diversion Dams). Sheet pile driving could also invoke short-term avoidance of these areas by juvenile salmonids although the sound levels generated (120dB to 160dB) are not expected to cause injury or death of these fish.

e. *Blasting*

Certain aspects of the proposed construction plan may require blasting of the bedrock which is found throughout the project area. Blasting activities near the stream channel may generate percussion-related shock waves that could cause injury or death of eggs, larvae, juvenile and adult fish. There are only two areas accessible to anadromous salmonids where blasting may occur. Those are below Coleman and Eagle Canyon Diversion Dams. At both sites all blasting will be done on dry land and no underwater blasting is proposed.

Underwater blasting has been reported to cause greater impacts to fish than blasting on land, adjacent to fish-bearing waters [Jones and Stokes Associates, Inc. (J&S) 2001]. Vibration and hydrostatic pressure waves generated by blasting activities have been reported to adversely impact all life stages of fish (Washington *et al.* 1992; Keevin 1998; J&S 2001; Bonneville Power Administration 2002). Rapid increases in hydrostatic pressure and subsequent decreases to below ambient pressures produced by underwater blasting have been reported to rupture internal organs, especially the swim bladder of all non-embryonic life stages of fish (Washington *et al.* 1992; J&S 2001). Sublethal effects of vibration, such as movement of fish into less suitable habitats, have also been reported (Bonneville Power Administration 2002).

Investigators have found the swim bladder to be the most frequently damaged organ associated with blasting-induced mortality (Christian 1973; Faulk and Lawrence 1973; Linton *et al.* 1985; Yelverton *et al.* 1975). The swim bladder, a gas-containing organ, is subject to rapid contraction and overexertion in response to the explosive shock waveform (Wiley *et al.* 1981). Because the swim bladder appeared to burst outward, some investigators have suggested that the negative phase (relative to ambient) of the pressure wave is responsible for damage to the swim bladder (Anonymous 1948; Hubbs and Rechnitzer 1952; Wiley *et al.* 1981).

Blasting in rock near, but not within, the active watercourse presents a much different scenario than blasting underwater. When complete confinement of the explosive is achieved (*i.e.*, no explosive gases are vented into the water), water pressure is generated only by seismic waves (Oriard 1985). The maximum transferred energy ratio of these waves is produced when the substrate is solid, unbroken rock and the rock/water boundary is perpendicular. Under these conditions energy transfer ratio is approximately 37 percent. Oriard (1985) describes the scenario in which the rock/water boundary deviates from perpendicular, as it will with the sloping shoreline found at the project sites. The amount of energy transferred decreases slowly as the slope of the boundary layer decreases. Another important change takes place when the slope decreases from perpendicular. At increasingly oblique angles of incidence, there is a corresponding increase in the duration of the incoming pulse. This fact has a significant bearing on the effects of pressure waves in water because it is usually favorable to increase the time period that the pressure is increasing, even if the peak pressure is not decreased, because a slower increase in pressure is less likely to burst the fish's air bladder or cause other structural damage to the body of the fish (Oriard 1985).

The Canadian Department of Fisheries and Oceans' "*Guidelines for the Use of Explosives in Canadian Fisheries Waters,*" has guidelines for on-shore setback distances from fish habitat based on substrate type to meet the maximum pressure guideline of 100 kPa to avoid physical impacts to fish. The equation for determining setback distance in rock is:

$$R = \sqrt{W} * K$$

Where: R = the minimum setback distance (m)
W = the weight of the charge (kg)
K = 5.03 (a coefficient for blasting in rock)

Applying this equation using the expected maximum charge weight of 20 pounds proposed for this project results in the following:

$$R = \sqrt{W} * K = \sqrt{9.07} * 5.03 = \underline{15.15}$$

Therefore, to meet the Canadian Department of Fisheries and Oceans' criteria the setback distance of a 20-pound charge will have to be a minimum of 15.15 m or approximately 50 feet from the active channel of Battle Creek. The blasting that is proposed at the Coleman Diversion Dam will occur no less than 100 feet from the active channel and therefore is not expected to adversely impact listed salmonids. The blasting below Eagle Canyon Diversion Dam could occur closer to the stream channel, but again, this area does not provide suitable habitat for salmonids and impacts will be expected to be minor. Judging from extensive monitoring of this area, the maximum expected impact will be mortality of one adult Chinook salmon and five juvenile steelhead (*i.e.*, the maximum number of salmonids observed in this area over several years of monitoring; FWS unpublished data).

f. *Instream Construction and Channel Dewatering*

Construction activities could disturb steelhead and Chinook salmon habitat in the stream channel. Construction activities associated with removing the five dams will include dismantling and removing Wildcat, Coleman, Lower Ripley Creek Feeder, Soap Creek Feeder, and South Diversion Dams and their appurtenant facilities. Construction of the tailrace connectors between South Powerhouse and Inskip Canal and between Inskip Powerhouse and Coleman Canal will also include work in the stream channel. Heavy equipment will be used in the stream channel to remove the concrete structures, gravel, rock, and other materials from the dam footprints or to prepare the sites for construction of facilities. To a lesser degree, construction of fish screens and fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams will also disturb the channel bottom and bank. The disturbance of the channel bottom and bank will alter the channel dimensions and form and the existing substrate.

The affected habitat area will be small relative to total spawning and rearing habitat in Battle Creek, and the existing channel structure and substrate at some locations to be altered provides poor or no spawning or rearing habitat. Some effects of the proposed construction activities (*e.g.*, release of suitable spawning gravel and larger boulders from behind dams) are expected to improve spawning and rearing habitat in these less productive areas.

An on-site fish biologist will ensure that debris from the existing instream facilities will be removed to the extent that it will not affect upstream migration of juvenile and adult steelhead and Chinook salmon and will not adversely impact spawning (*e.g.*, armoring) or rearing habitat.

Dewatering portions of the stream channel and temporarily removing fish ladders during construction may disrupt movement and migration of fish species. Construction activities within the stream channel will include placement of cofferdams to isolate construction areas from the streamflow. Depth and velocity conditions that support movement and migration of fish species may be interrupted temporarily and result in isolation of listed salmonids. Placement of cofferdams in the stream channel may likewise trap listed salmonids. Fish that become trapped in isolated pockets of water may be killed during dewatering of the construction area or other construction activities.

Due to construction sequencing and closure of the fish ladders on Eagle Canyon and Coleman Diversion Dams, these two construction sites, along with the Wildcat Diversion Dam site, will be the only areas where anadromous salmonids might be directly affected by these construction impacts. An on-site crew of fish biologists will implement fish rescue operations in any isolated pools or enclosed cofferdams that may harbor isolated fish. Fish will be removed from isolated pools by seining or electroshocking and released in the live channel upstream of the construction area. It is estimated that of the fish captured, not more than 10 percent may be killed during the rescue operations.

2. Beneficial Effects of the Project

The most prominent and long-lasting effects on listed salmonids that are expected to result from the Restoration project are anticipated to be highly beneficial to these species in Battle Creek.

a. *Substantial Increase in Spawning and Rearing Habitat Area in Response to Increased*

Minimum Instream Flow Requirements

The Restoration project will increase the minimum instream flow requirements in multiple reaches of Battle Creek and its tributaries, and is likely to have a substantial beneficial effect on steelhead and Chinook salmon. The increased flow will increase spawning and rearing habitat area for winter-run Chinook salmon, spring-run Chinook salmon, steelhead, and fall-late fall-run Chinook salmon (Tables 5 and 6). The total spawning and rearing habitat areas will be several times greater than the current area. The increased spawning and rearing habitat area will be expected to increase the abundance of steelhead and spring-, winter-, and fall-/late fall-run Chinook salmon.

Limited information is available for flow-habitat relationships on Soap, Ripley, and Baldwin Creeks. The removal of diversion dams on Soap and Ripley Creeks and the substantial increase in required minimum flow (*i.e.*, greater than zero) will provide spawning and rearing habitat that will support additional steelhead and possibly Chinook salmon, contributing to the beneficial effects identified above. Although the contribution cannot be quantified, the increased flow is anticipated to provide spawning and rearing habitat for salmonids that does not exist under baseline conditions, especially for steelhead (Kier Associates 1999).

In addition to the automatic increase in minimum flow requirements, the Restoration project includes an Adaptive Management Plan which includes sufficient funding to support future increases in minimum flows and provides for the collection of new data and information to allow managers to more efficiently use available flows relative to fish habitat needs.

Table 5. Calculated spawning area (acres) for peak months of steelhead and Chinook salmon occurrence for minimum flow requirements

Reach of Battle Creek	Steelhead Spawning Area [a]	Spring-Run Chinook Salmon Spawning Area [b]	Winter-Run Chinook Salmon Spawning Area [c]	Late Fall–Run Chinook Salmon Spawning Area [d]
Baseline				
Keswick	0.06	–	–	–
North Battle Creek Feeder	0.01	0.04	0.04	0.04
Eagle Canyon	0.01	0.07	0.07	0.07
Wildcat	–	0.05	0.05	0.05
South	0.12	0.39	0.39	0.39
Inskip	–	0.2	0.2	0.2
Coleman	–	0.17	0.17	0.17
Main	0.27	0.55	0.55	0.55
Total	**0.47**	**1.47**	**1.47**	**1.47**
Restoration Project				
Keswick	0.06	–	–	–
NBC Feeder	0.89	0.69	0.69	0.63
Eagle Canyon	0.57	0.44	0.44	0.39
Wildcat	0.34	0.28	0.28	0.25
South	0.95	0.71	0.71	0.67
Inskip	2.08	1.62	1.62	1.47
Coleman	1.22	0.98	0.98	0.96
Main	1.36	1.96	1.96	1.67
Total	**7.47**	**6.68**	**6.68**	**6.04**

Note: If the removal of a dam under an alternative precludes the need for a minimum flow requirement, the minimum flow requirement for the adjacent upstream or downstream dam is applied.

[a] Values are for the month of February.

[b] Values are for the month of September.

[c] Values are for the month of June.

[d] Values are for the month of March.

Table 6. Calculated rearing area (acres) for peak months of steelhead and Chinook salmon occurrence for minimum flow requirements

Reach of Battle Creek	Steelhead Rearing Area [a]	Spring-Run Chinook Salmon Rearing Area [b]	Winter-Run Chinook Salmon Rearing Area [c]	Late Fall–Run Chinook Salmon Rearing Area [d]
Baseline				
Keswick	1.92	–	–	–
North Battle Creek Feeder	1.62	0.62	0.62	0.62
Eagle Canyon	1.02	0.41	0.41	0.41
Wildcat	0.9	0.36	0.36	0.36
South	4.26	2.17	2.17	2.17
Inskip	2.3	0.53	0.53	0.53
Coleman	0.11	0.37	0.37	0.37
Main	13.18	4.39	4.39	4.39
Total	**25.31**	**8.85**	**8.85**	**8.85**
Restoration Project				
Keswick	1.92	–	–	–
NBC Feeder	6.06	4.14	4.68	4.68
Eagle Canyon	2.93	2.42	2.42	2.42
Wildcat	2.62	2.23	2.23	2.23
South	6.82	4.38	4.75	4.75
Inskip	7.37	5.72	5.85	5.85
Coleman	3.53	2.74	2.73	2.73
Main	12.3	16.15	17.14	17.14
Total	**43.55**	**37.78**	**39.8**	**39.8**

Note: If the removal of a dam under an alternative precludes the need for a minimum flow requirement, the minimum flow requirement for the adjacent upstream or downstream dam is applied.

[a] Values are for the month of July.

[b] Values are for the month of February.

[c] Values are for the month of October.

[d] Values are for the month of July.

b. *Substantial Increase in Survival During Spawning and Rearing Life Stages in Response to Cooler Water Temperatures.*

Under the Restoration project minimum instream flow requirements, release of presently diverted spring water will be increased over present FERC requirements in the reaches downstream of the North Battle Creek Feeder Diversion Dam on North Fork Battle Creek and downstream of the South Diversion Dam on South Fork Battle Creek. While the precise level of cooling in each reach and tributary of Battle Creek in different seasons is difficult to determine, water temperature modeling indicates that the higher flows and cold spring waters will substantially cool water temperature throughout all but two short segments of the creek, especially during the warmer periods, and are expected to provide beneficial effects to Chinook salmon and steelhead (Reclamation 2004). There are two short segments in South Fork Battle Creek where baseline conditions provide cooler summertime temperatures than that of the Restoration project. This condition occurs because Inskip and South Powerhouses currently inject cooler North Fork water into South Fork Battle Creek. However, the powerhouses do not reliably inject cooler water under baseline conditions because canal and turbine outages occur at unpredictable times, thereby producing substantial temperature fluctuations that reduce habitat value compared to the stabilized conditions under the Restoration project.

c. *Improvements to Migration*

There are several aspects of the Restoration project which are expected to improve habitat conditions to allow salmonids to migrate more freely throughout the restored areas of the Battle Creek and its tributaries.

(1) *Higher Instream Flows*. Increased minimum instream flows will improve conditions that facilitate passage over natural barriers for anadromous salmonids. The increased ability of salmonids to pass the natural falls and cascades found within the action area will increase the survival of these fish due to reduced potential for injury and exhaustion related to multiple attempts at passing partial barriers during minimum flow conditions. Improved passage also will facilitate the distribution of adults to available upstream spawning habitat that could increase survival of eggs and production of fry. The proposed increase in minimum instream flows will not elevate the flow to levels that could impair passage over natural obstacles. In addition, the adaptive management process provides for future adjustments in instream flows to facilitate improvements in passage conditions throughout the action area.

(2) *Removal of Five Dams and Construction of More Effective Fish Ladders*. The removal of five dams and the construction of more effective fish ladders will facilitate passage and is likely to benefit listed salmonids. Removal of Wildcat, Coleman, Soap Creek Feeder, Lower Ripley Creek Feeder, and South Diversion Dams and construction of improved fish ladders on North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams will provide significantly greater upstream passage efficiency relative to current passage conditions. The removal of dams and construction of new ladders will substantially increase unimpeded access to upstream spawning habitat. Survival of adult Chinook salmon and steelhead will increase because of reduced potential for injury, delay, and exhaustion related to multiple attempts at passing the dams without effective fish ladders that meet current design standards. Improved passage will also facilitate distribution of adults to available upstream spawning habitat, which could increase survival of eggs and production of smolts.

(3) ***Separation of the Powerhouse Water Discharge from the Natural Stream Channel.*** Ceasing the discharge of North Fork Battle Creek water to South Fork Battle Creek will guard against the potential for false attraction to South Fork Battle Creek that exists under baseline conditions. This could potentially increase spawning success and fry production because it will facilitate the return of adult Chinook salmon and steelhead to natal spawning habitat in South Fork and North Fork Battle Creek and stabilize the temperature regime in the South Fork. Water temperature is naturally warmer in South Fork Battle Creek, and optimal spawning and rearing habitat is less available for Chinook salmon and steelhead than in North Fork Battle Creek, especially during extremely dry years (PG&E 2001). Therefore, false attraction of salmonids originating from the North Fork into the South Fork could result in lower overall production for the Battle Creek Watershed.

Removing the two powerhouse tailraces from the migratory corridor will eliminate false attraction into the tailraces where: there is no spawning habitat; adults face potential injury from the turbine; and adults waste energy swimming against large powerhouse discharge that can distract them from their migration.

With cessation of the discharge of North Fork water into the South Fork at Inskip and Coleman Diversion Dams, the gradient of warm to cool water temperatures from downstream to upstream will be restored. The restoration of the gradient may help ensure movement of adult salmonids to cool reaches upstream of South Diversion Dam. Flow and water temperature fluctuations that may occur during powerhouse outages will be minimized, and warming of Inskip and Coleman reaches during the outages will no longer occur.

d. *Elimination of Entrainment into Hydropower Diversions*

The elimination of some diversions and construction of fish screens at the remaining diversions will substantially increase survival of juvenile steelhead and Chinook salmon during downstream movement and migration. Under the Restoration project, diversions will be eliminated at South, Coleman, and Wildcat Diversion Dams. Fish screens will be constructed on all remaining diversions at Inskip, North Battle Creek Feeder, and Eagle Canyon Diversion Dams. The new failsafe fish screens will be expected to virtually eliminate entrainment losses of juvenile Chinook salmon and steelhead by automatically shutting down diversion during any mechanical breakdowns of the screens.

e. *Reduced Predation*

Reduction of predation-related mortality may occur as a result of removing Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams. The existing dams are thought to concentrate salmonid predators such as Sacramento Pikeminnow (*Ptychocheilus grandis*) by stopping or delaying their upstream migration and by enhancing the habitat features that favor predatory success. Also, juvenile salmonids passing over the dams are likely to be disoriented by turbulent flow conditions and become more vulnerable to predation. Removal of these five dams will remove any potential effects they may have on predation.

f. *Increased Food Production and Reduced Pathogens*

Increased minimum instream flows may result in a substantial increase in the production of food for rearing salmonids. The quantity of habitat available for the production of periphyton and aquatic macroinvertebrates is at least partially dependent on the stream surface area. Periphyton is a key component of the aquatic food web and aquatic macroinvertebrates are a primary food for fish, especially juvenile Chinook salmon and steelhead. In addition, increasing the minimum instream flow and decreasing the temperature in typical salmonid holding habitats will decrease the adverse affects of pathogens.

Under baseline conditions, the summer stream surface area is approximately 108.9 acres (Reclamation 2004). In response to increased minimum instream flow requirements, the summer stream surface area will increase by approximately 66 acres (60 percent) under the Restoration project. The benefits of this increase in habitat will be most apparent in future years when population size increases along with competition for food.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

A. Aquaculture and Fish Hatcheries

Mount Lassen Trout Farms, Inc. consists of nine private trout-rearing facilities located within the Battle Creek Watershed. This operation rears rainbow and brown trout for stocking in private ponds and lakes throughout California. Although the facilities are located above the anadromous habitats of Battle Creek, some facilities are located near the hydroelectric project canals. These facilities have been certified as disease free for many years and the potential for fish or disease to escape from these facilities into Battle Creek is considered very small. No such impacts have ever been documented from these facilities and they are not expected to occur in the future.

Darrah Springs Fish Hatchery is located on Baldwin Creek, a tributary to mainstem Battle Creek. It is a key hatchery of CDFG's inland fisheries program and raises catchable trout for recreational fisheries. It is possible that fish or disease could escape the hatchery into Battle Creek, but again, no such impacts have ever been documented and are not expected to occur in the future.

B. Agricultural Practices

The primary agricultural practices in the Battle Creek Watershed consist of low density livestock grazing and small timber harvests. These practices have not produced measurable adverse impacts to salmonids or salmonid habitat in Battle Creek (Reclamation 2003). There are no current plans to modify the type or intensity of agricultural practices in the watershed and therefore any such changes could not be considered reasonably certain to occur. As discussed in the next section, conservation easements and agreements are being pursued along the riparian corridors of the Battle Creek Watershed, providing further assurance that future agricultural and other human practices will not be likely to adversely affect salmonids or salmonid habitat.

C. Conservation Agreements and Easements

The Battle Creek Watershed Conservancy and The Nature Conservancy have been working together in developing conservation agreements and easements throughout the riparian corridors and uplands of the Battle Creek Watershed. Several agreements and easements have already been established and several more are being pursued. Implementation of these agreements and easements is expected to, at a minimum, maintain the current high quality of riparian and aquatic habitat in Battle Creek, and could potentially improve the condition of these habitats for salmonids.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

Populations of Chinook salmon and steelhead in California have declined drastically over the last century and some subpopulations of salmonids have been lost. There are three ESUs of salmonids in the Central Valley listed as endangered or threatened under the ESA, and their current status, based upon their risk of extinction, has not significantly improved since listing (NMFS 2003). The severe declines largely are attributable to the loss of high quality habitat, which the Restoration project is anticipated to directly address.

A. Impacts of the Proposed Action on ESU Survival and Potential for Recovery

The most significant long-term effect of the Restoration project will be to improve overall conditions for listed salmonids by increasing the amount of high quality habitat available. This increase in high quality habitat will be achieved through removing passage barriers, increasing minimum instream flows, reducing juvenile entrainment into hydropower diversions, and eliminating mixing of North Fork waters into South Fork Battle Creek. There are expected to be some minor, short-term adverse effects associated with construction of the Restoration project facilities.

Short-term, construction-related effects include a slight potential to cause harm through increased sediment loading or other water-quality impacts due to increased erosion or accidental spills of hydrocarbons. There is also the possibility that pile-driving and blasting activities could kill, harm or harass juvenile and adult listed salmonids at a limited number of construction sites. Finally, there is the potential for listed salmonids to become trapped within isolated pools and behind cofferdams when Battle Creek flows are diverted away from construction areas. These trapped fish could be exposed to higher water temperatures, increased predation, and up to 10 percent mortality during rescue operations intended to return these fish to the flowing stream channel. Several impact avoidance and minimization measures, including a SWPPP, a SPCP, and implementation of BMPs have been incorporated into the project plan. These and other impact avoidance and minimization measures are expected to protect listed salmonids and water quality in Battle Creek to the greatest extent possible.

The adverse effects that are anticipated to result from the Restoration project are not of the type or magnitude that will be expected to appreciably reduce the likelihood of survival and recovery of the affected species within the action area. NMFS expects that any adverse effects of this project will be greatly outweighed by the long-term benefits to species survival produced by the improvement in spawning, rearing and holding habitat for all three listed salmonids in Battle Creek.

B. Impacts of the Proposed Action on Proposed Critical Habitat

The Restoration project has the potential to cause some minor, short-term adverse effects on proposed critical habitat for Central Valley spring-run Chinook salmon and Central Valley steelhead as discussed above. However, the long-term effects of the Restoration project are anticipated to be highly beneficial to these species and are expected to greatly enhance the conservation value of proposed critical habitat in Battle Creek.

VIII. CONCLUSION

After reviewing the best scientific and commercial data available, including the current status of endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the Restoration project is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead.

After reviewing the best scientific and commercial data available, including the current status of proposed Central Valley spring-run Chinook salmon and Central Valley steelhead critical habitat, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' conference opinion that the Restoration project is not likely to destroy or adversely modify proposed critical habitat for Central Valley spring-run Chinook salmon or Central Valley steelhead.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by Reclamation so that they become binding conditions of any licenses issued, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activities covered by this Incidental Take Statement. If Reclamation: (1) fails to assume and implement the terms and conditions; or (2) fails to require the construction contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the contracts, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation must report the progress of the action and its impact on the species to NMFS as specified in this Incidental Take Statement (50 CFR §402.14(I)(3)).

A. Amount or Extent of Take

The impacts associated with the implementation of the Restoration project have the potential to harm, harass, capture or kill juvenile and adult life stages of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Such take is expected to result from blasting of rock adjacent to the stream channel, instream construction of cofferdams (sheet pile driving), entrapment of fish within cofferdams and other isolated pools, and rescue operations to return those entrapped fish to the creek. The potential for take to occur exists at only three near-stream construction sites (*i.e.*, Wildcat, Eagle Canyon, and Coleman Diversion Dams; see below) due to inaccessibility of the other sites to anadromous salmonids. There also is the potential for construction activities and dam removals to cause increased sedimentation in Battle Creek due to increased erosion and redistribution of instream sediments. However, the level of sedimentation caused by the proposed activities is not anticipated to cause take of listed salmonids, primarily due to the avoidance and minimization measures that have been incorporated into the project plan.

The actual number of individuals likely to be subjected to each form of take is not possible to determine due to annual variations in population size, run timing, meteorological conditions, and distribution of listed salmonids in Battle Creek. However, in those cases where actual numbers of fish to be taken cannot be determined it is possible to describe the conditions that will lead to the maximum amount of incidental take anticipated in this biological opinion. NMFS uses these conditions as surrogates to determine if the level of incidental take has been exceeded. Specifically, take from the project is not expected to exceed that associated with:

1. *Excavation blasting on dry land at the Coleman and Eagle Canyon Diversion Dam construction sites.* Blasting at the Coleman Diversion Dam site is expected to occur at least 100 feet from the active river channel and will follow all of the conservation

measures previously described in this document, and therefore not expected to adversely affect listed salmonids. Blasting at the Eagle Canyon Diversion Dam site may occur directly adjacent to the active stream channel and therefore may result in direct mortality of a maximum of one adult spring-run Chinook salmon and five juvenile steelhead.

2. *Instream sheet pile driving associated with construction of cofferdams at Wildcat and Coleman Diversion Dams.* Only those steelhead eggs that are deposited within 150 feet of pile driving activities after March 1 of the construction year are expected to be lost due to pile driving at Wildcat and Coleman Diversion Dams, which are the only two accessible construction sites that provide suitable steelhead spawning habitat. Eggs deposited prior to March 1 will be expected to have hatched out by May 1, and will be unharmed by pile driving. In considering the size of the area to be affected compared to the total amount of spawning habitat in Battle Creek, and the time period in which effects will occur compared to the full spawning period for steelhead, less than 1 percent of the total annual production of steelhead eggs on Battle Creek is expected to be lost.

3. *Entrapment of juvenile salmonids inside of cofferdams or in isolated pools resulting from dewatering of instream construction areas at Wildcat, Eagle Canyon and Coleman Diversion Dams.* Fish rescue operations consisting of seining and/or electrofishing all enclosed or isolated water bodies capable of holding fish will be conducted at these three construction sites. A maximum of 10 percent of listed salmonids handled during rescue operations are expected to be lost during rescue attempts

Anticipated incidental take may be exceeded if project activities exceed the criteria described above or if the project is not implemented as described in the BA for the Restoration project, including the full implementation of the proposed conservation measures listed in the *Description of the Proposed Action* section.

B. Effect of the Take

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, or Central Valley steelhead.

In the accompanying conference opinion, NMFS determined that this level of anticipated take is not likely to result in the destruction or adverse modification of proposed critical habitat for Central Valley spring-run Chinook salmon or Central Valley steelhead.

C. Reasonable and Prudent Measures

Pursuant to section 7(b)(4) of the ESA, the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead:

1. Due to close cooperation between Reclamation and NMFS throughout the planning and development of this project, NMFS believes that all measures which are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central

Valley spring-run Chinook salmon, and Central Valley steelhead have already been incorporated into the Restoration project plan. Therefore, the only requirement will be for thorough monitoring and reporting to NMFS on the efficacy of the proposed conservation measures and any documented take that results from construction of the Restoration project.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. Due to close cooperation between Reclamation and NMFS throughout the planning and development of this project, NMFS believes that all measures which are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead have already been incorporated into the Restoration project plan. Therefore, the only requirement will be for thorough monitoring and reporting to NMFS on the efficacy of the proposed conservation measures and any documented take that results from construction of the Restoration project.

a. Reclamation shall closely monitor all construction activities and report any incidences of take of listed salmonids within 48 hours to NMFS at the contact information below.

b. Reclamation shall provide annual reports to NMFS within six months of the close of each instream/near-stream construction season (*i.e.*, approximately May 1, following a November 1 close of construction). These reports shall include: a summary of total numbers of listed salmonids encountered, captured, or killed during construction and rescue operations; progress on construction elements and updated timelines for project completion; and efficacy of erosion control and other conservation measures and descriptions of any unforeseen problems or incidents that may have affected listed salmonids.

Updates and reports required by these terms and conditions shall be submitted to:

Supervisor
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

X. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. These conservation recommendations include discretionary measures that Reclamation can take to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, NMFS provides the following conservation recommendation that will reduce or avoid adverse impacts on the listed species:

1. Reclamation should work closely with construction contractors in developing their blasting plans to try to avoid or minimize blasting adjacent to the active stream channel and to minimize charge sizes used in order to reduce to the greatest extent possible the likelihood of causing injury to listed salmonids.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed Restoration project. Reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

Reclamation may request NMFS to confirm the conference opinion as a biological opinion if the proposed critical habitat designations become final. The request must be in writing. If NMFS reviews the proposed action and finds that there have been no significant changes to the action or in the information used during the conference, NMFS will confirm the conference opinion as the biological opinion on the project, and no further section 7 consultation will be necessary.

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Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act (MSA)

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS[1]
U.S. Bureau of Reclamation Battle Creek Salmon and Steelhead Restoration project

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The geographic extent of freshwater essential fish habitat (EFH) for the Pacific salmon fishery includes waters currently or historically accessible to salmon within specific U.S. Geological Survey hydrologic units (Pacific Fishery Management Council 1999). EFH is defined as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH, "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

The associated biological opinion (Enclosure 1) thoroughly addresses the species of Chinook salmon listed both under the Endangered Species Act (ESA) as well as the MSA which potentially will be affected by the proposed action–Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) and Central Valley spring-run Chinook salmon (*O. tshawytscha*). Therefore, this EFH consultation will concentrate primarily on the Central Valley fall/late fall-run Chinook salmon (*O. tshawytscha*) which is covered under the MSA, although not listed under the ESA.

The Sacramento, Feather, Yuba, American, Cosumnes, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin Rivers, and many of their tributaries, support wild populations of Central Valley fall-/late fall-run (herein "fall-run") Chinook salmon. However, 40 to 50 percent of spawning and rearing habitats once used by these fish have been lost or degraded. Fall-run Chinook salmon once were found throughout the Sacramento and San Joaquin River drainages, but have suffered declines since the mid-1900s as a result of several factors, including commercial fishing, blockage of spawning and rearing habitat, water flow fluctuations, unsuitable water temperatures, loss of fish in overflow basins, loss of genetic fitness and habitat competition due to straying hatchery fish, and a reduction in habitat quality.

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[1] The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) set forth new mandates for NOAA's National Marine Fisheries Service (NMFS) and Federal action agencies to protect important marine and anadromous fish habitat. Federal action agencies which fund, permit, or carry out activities that may adversely impact EFH are required to consult with NMFS regarding potential adverse effects of their actions on EFH, and respond in writing to NMFS "EFH Conservation Recommendations." The Pacific Fisheries Management Council has identified essential fish habitat (EFH) for the Pacific salmon fishery in Amendment 14 to the Pacific Coast Salmon Fishery Management Plan.

Chinook salmon in the Sacramento/San Joaquin Basin are genetically and physically distinguishable from coastal forms (Clark 1929). Additionally, San Joaquin River populations tend to mature at an earlier age and spawn later in the year than Sacramento River populations. These differences could have been phenotypic responses to the generally warmer temperature and lower flow conditions found in the San Joaquin River basin relative to the Sacramento River basin. There is no apparent difference in the distribution of marine coded wire tag (CWT) recoveries from Sacramento and San Joaquin River hatchery populations, nor are there genetic differences between Sacramento and San Joaquin River fall-run populations (based on DNA and allozyme analysis) of a similar magnitude to that used in distinguishing other ESUs. This apparent lack of distinguishing life-history and genetic characteristics may be due, in part, to large-scale transfers of Sacramento River fall-run Chinook salmon into the San Joaquin River basin.

The historical abundance of fall-run Chinook salmon is poorly documented (Myers *et al.* 1998) and complete estimates are not available until 1953 (U.S. Fish and Wildlife Service [FWS] 1995). From the late 1930s to the late 1950s estimates for mainstem Sacramento River fall-run fish were obtained from spawning surveys and ladder counts at the Anderson-Cottonwood Irrigation Dam. Although surveys were not consistent or complete, they did yield population estimates for fall-run Chinook salmon in the Sacramento River ranging from 102,000 to 513,000 fish (Yoshiyama *et al.* 1998). Average escapement from 1953 to 1966 was 179,000 fish and from 1967 to 1991 was 77,000 (FWS 1995). From 1992 to 1997 the estimated fall-run population in the Sacramento River has ranged from 107,300 to 381,000 fish (Yoshiyama *et al.* 1998). Over the last 5 years average escapement of naturally produced fall-run has been above 190,000; however, 20 to 40 percent of these natural spawners have been of hatchery origin. The increase in salmon runs in the Sacramento River since 1990 may be attributable to several factors including, increased water supplies following the 1987-1992 drought, stricter ocean harvest regulations, and fisheries restoration actions throughout the Central Valley. However, it is unclear if natural populations are self-sustaining or if the appearance of a healthy population is due to high hatchery production. Concern remains over impacts from high hatchery production and harvest levels, although ocean and freshwater harvest rates have been recently reduced.

Fall-run Chinook salmon comprise the largest population of Chinook salmon in Battle Creek. Fall-run Chinook salmon are intentionally restricted from entering the Restoration project area because of concern about transmitting infectious hematopoietic necrosis (IHN) into the water supply for the Coleman National Fish Hatchery (FWS 1997) and potential problems that excessive numbers of fall-run fish pose to the small numbers of spring- and winter-run Chinook salmon. During the past 5 years of record, an average of about 95,000 adult fall-run Chinook salmon returned to Battle Creek, of which an average of nearly 34,000 were allowed to enter the Coleman National Fish Hatchery. The remaining fall-run Chinook salmon are mostly confined downstream of the Coleman National Fish Hatchery barrier weir, outside the Restoration project area (FWS 2001). The abundance of fall-run Chinook salmon in the Battle Creek watershed has increased substantially since about 1980. Fishery managers have conventionally believed that most of these fall-run Chinook salmon are of Coleman National Fish Hatchery origin (Kier Associates 1999). However, recent research suggests that as many as one-third of the fall-run Chinook salmon returning to the creek were the product of fish that spawned naturally in lower Battle Creek (FWS 2001).

A. Life History and Habitat Requirements

Central Valley fall-run Chinook salmon are "ocean-type," entering the Sacramento River from July through December, and spawning from October through January. Peak spawning occurs in October and November (Reynolds *et al.* 1993). Chinook salmon spawning generally occurs in swift, relatively shallow riffles or along the edges of fast runs at depths up to 15 feet. Preferred spawning substrate is clean loose gravel. Gravels are unsuitable for spawning when cemented with clay or fines, or when sediments settle out onto redds reducing intergravel percolation (NMFS 1997).

Egg incubation occurs from October through March, and juvenile rearing and smolt emigration occurs from January through June (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and estuary (Kjelson *et al.* 1982). The remainder of fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, tributary streams are used as rearing habitat. These non-natal rearing areas are highly productive micro-habitats providing abundant food and cover for juvenile Chinook salmon to grow to the smolt stage. Smolts are juvenile salmonids that are undergoing a physiological transformation that allows them to enter saltwater. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

In contrast, the majority of fry carried downstream soon after emergence are believed to reside in the Delta and estuary for several months before entering the ocean (Healey 1980, 1982; Kjelson *et al.* 1982). Principal foods of Chinook salmon while rearing in freshwater and estuarine environments are larval and adult insects and zooplankton such as *Daphnia,* flies, gnats, mosquitoes or copepods (Kjelson *et al.* 1982), stonefly nymphs or beetle larvae (Chapman and Quistdorff 1938) as well as other estuarine and freshwater invertebrates. All outmigrant Central Valley fall-run Chinook salmon depend on passage through the Sacramento-San Joaquin Delta for access to the ocean. They remain off the California coast during their ocean residence and migration.

II. DESCRIPTION OF THE PROPOSED ACTION

The proposed action is described in the *Description of the Proposed Action* section of the associated biological opinion (Enclosure 1) for the endangered Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, and threatened Central Valley steelhead ESUs.

III. EFFECTS OF THE ACTION

The Restoration project is expected to have a relatively neutral effect on fall-run Chinook salmon EFH as fall-run fish currently are excluded from the area where the primary effects will occur (above the CNFH barrier weir) for management purposes discussed above. The adaptive management plan for the Restoration project allows for the potential re-establishment of a natural fall-run of Chinook salmon population in the Restoration project area, but only after healthy, viable populations of the listed Chinook salmon become established, and it is determined that a managed population of natural fall-run can be allowed to develop in the area without adversely affecting the other listed populations of Chinook salmon.

In this manner, the Restoration project is not expected to adversely affect fall-run Chinook salmon EFH during the construction phase (because fall-run fish do not occur in the construction impact areas), but there is a potential for the Restoration project to have a positive effect on fall-run Chinook salmon over time, due to the potential for opening up new habitat for them in the future.

As discussed above, EFH protections apply to all ESUs of Pacific Chinook salmon, so the adverse construction effects that will impact the habitat occupied by spring-run Chinook salmon are also considered adverse effects on EFH. Those effects are thoroughly detailed in the biological opinion for the Restoration project (Enclosure 1).

IV. CONCLUSION

Upon review of the effects of the Restoration project, NMFS believes that some project construction activities may adversely affect EFH of Pacific salmon protected under the MSA.

V. EFH CONSERVATION RECOMMENDATIONS

As the habitat requirements of Central Valley fall-run Chinook salmon within the action area are similar to those of the federally-listed species addressed in the attached biological opinion, NMFS recommends that the ESA conservation recommendation included in the biological opinion prepared for the Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead ESUs, be adopted as an EFH conservation recommendation.

VI. ACTION AGENCY STATUTORY REQUIREMENTS

Section 305(b)(4)(B) of the MSA and Federal regulations (50 CFR § 600.920) to implement the EFH provisions of the MSA require Federal action agencies to provide a detailed written response to NMFS, within 30 days of its receipt, responding to the EFH conservation recommendations. The response must include a description of measures adopted by the Agency for avoiding, mitigating, or offsetting the impact of the project on Pacific salmon EFH. In the case of a response that is inconsistent with NMFS' recommendations, the Agency must explain their reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(j)).

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